

The Milbank Memorial Fund
QUARTERLY

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IN THIS ISSUE

DIETARY studies have shown that a large proportion of industrial workers consume diets which furnish much less than recommended amounts of the principal vitamins, and clinical studies on nutritional status have revealed that deficiency states in various stages but below the level of classical deficiency diseases are very prevalent. Such data have directed attention to the question "What benefits would result from a balanced, adequate diet or from the correction of deficiency states by administering vitamin therapy?" The findings presented by Dr. Henry Borsook in a report on "Effects of Vitamin Supplementation on Absenteeism, Turnover, and Personnel Ratings" which is the third paper from an investigation of "Nutritional Status of Aircraft Workers in Southern California," are an important contribution in the assembling of evidence on the results of vitamin therapy.

In this investigation, six vitamins and calcium were given to one group and placebos to a control group for a period of nine to twelve months. The groups had similar personnel ratings at the beginning of the study, nonmilitary terminations of employment were approximately equal in the first few months, and absenteeism did not differ significantly during the first six months. In the second six months, absenteeism from all causes was 19 per cent less for employees receiving the vitamins than for those receiving the placebos; for the twelve-month period, nonmilitary terminations were 27 per cent fewer in the vitamin group than in the placebo group; and personnel ratings at the end of the study were significantly higher on the average for the vitamin subjects than for placebo subjects. It is of interest that a difference in absenteeism occurred only in the second six months, a fact which suggests that a fairly long therapy period is needed before effects are manifested in performance. Furthermore, most of the reduction in absenteeism was in causes other than specific illness or diseases, and this, together with higher personnel ratings, seems

to indicate that therapy resulted in an improved feeling of well-being or in what has been termed industrial morale.

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The nutritional welfare of workers in war industries has received special attention from the national governments, both in the United States and Canada. The administrative organization of the Federal agencies charged with the promotion of nutrition programs in industry and the services given and some of the accomplishments are reviewed by Dr. Robert S. Goodhart for the United States, and by Dr. L. B. Pett for Canada, in the article entitled "The War-Time Nutrition Programs for Workers in the United States and Canada." In addition to extensive diet education programs for workers, the government agencies have given much technical assistance in planning with management for adequate in-plant food-service facilities and have furnished scientific advice on menus and methods of cooking for large numbers of persons. Both management and governments are expected to continue their interest in industrial feeding programs after the war.

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Various studies have been made which indicate that the length of life of offspring is related to that of their parents. A further investigation of this subject in a relatively homogeneous rural population is presented in the paper, "Length of Life of Parents and Offspring in a Rural Community," by Sally Preas. Offspring of long-lived parents were found to have an advantage over those of short-lived parents with respect to the age at which death occurred. Interesting differences in causes of death were found between the offspring of the long-lived and the short-lived parents and also between the two groups of parents.

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NUTRITIONAL STATUS OF AIRCRAFT WORKERS IN SOUTHERN CALIFORNIA

III. EFFECTS OF VITAMIN SUPPLEMENTATION ON ABSENTEEISM, TURNOVER, AND PERSONNEL RATINGS¹

HENRY BORSOOK, M.D.²

THE effects of vitamin supplementation upon a group of aircraft workers are discussed in this third report (1, 2) from the study of the nutrition of aircraft workers in Southern California. The effects described in this report are on absenteeism, termination rates, and Merit Review Scores, or the ratings made at intervals on work performance of employees.

This report is divided into two parts. Part I explains the position

¹This Study of the nutrition of aircraft workers in California was sponsored by the Nutrition Committee (R. A. Millikan, Chairman), appointed by the Board of Supervisors of the County of Los Angeles, California, and the Committee on the Nutrition of Industrial Workers of the National Research Council. The Study was supported in part by the sponsors and by the following: the California Institute of Technology, The Lockheed Aircraft Corporation, the Milbank Memorial Fund, the War Production Board, and the Works Projects Administration (Project No. 12372). Support was also received from the California Fruit Growers Exchange, the Gelatin Products Corporation, Merck and Company, the National Oil Products Company, the Research Corporation, E. R. Squibb and Sons, and the Vita-Food Corporation.

We wish to thank the officials of the Lockheed Aircraft Corporation who authorized the Study and who offered us every facility to carry it out. Their contribution was especially noteworthy in that the Study was made during the years of rapid expansion (1942-1943), under the heavy stress such activity implies. We are greatly indebted especially to Mr. Robert E. Gross, President; Dr. F. E. Poole, Medical Director, to whose department this Study was assigned; Mr. Dwight L. Palmer, Manager, Industrial Relations Research Division; Mr. L. Stockford, Analyst, who participated in the collection of data and in the preparation of preliminary reports; and to Mr. R. B. Robertson, Assistant Director of Industrial Relations. It is a pleasure to record the patient friendliness and cooperation extended us by the personnel of the divisions of Active Files and Inactive Files, and by the supervisory staff in the plant.

We wish to thank the local union (affiliated with the A. F. of L.), to which the workers belonged, for its approval of the Study and for its cooperation.

We are indebted to Miss Dorothy G. Wiehl of the Milbank Memorial Fund for her searching criticism of the data in this report, for many valuable suggestions on the mode of presentation and assistance in the statistical analysis. We are indebted also to Miss Josephine Williams of the California Institute of Technology for her zeal and thoroughness in running down innumerable details in the Company records, and for her participation in the task of rechecking and tabulating all the data. We take this occasion, also, to thank Dr. Roger Stanton of the California Institute of Technology, who assisted us, as a volunteer, in every phase of the Study.

² California Institute of Technology, Pasadena.

of the present report in the series comprising a study on nutrition in industry. It compares the workers in this Study with the general industrial population. It explains the nature of the vitamin supplement used, and the nature of the placebo given one control group. It explains the selection and composition of the vitamin and placebo groups, and of a second control group selected to appraise the psychotherapeutic, as distinguished from the putative therapeutic, effect of a vitamin supplement. In order to appraise the possible contribution of changes in diet to the differences in industrial performance observed, a summarized analysis is presented of the two sets of diet histories, one taken at the beginning, the second at the end of the Study.

Part II presents the data on absenteeism, turnover, and Merit Review Scores, and discusses the differences which occurred in these respects between the groups during the year of the Study.

PART I

1. INTRODUCTION

It has been demonstrated repeatedly that the diets of most workers in the United States are inadequate. Some employers, persuaded that they can increase production by improving nutrition, have supplemented workers' diets with vitamin concentrates. But, at the time our Study began, this practice was not accompanied by studies of the nutritional status of workers before and after the feeding of vitamin supplements; nor, apparently, had there been any attempt to estimate from objective data obtained in controlled experiments what had been gained by the use of such supplements.

Accordingly, the Committee on the Nutrition of Industrial Workers recommended in 1941:

That adequately controlled studies be conducted in selected war or defense industries to determine the facts concerning the influence of diet

and nutrition on health, working capacity, incidence of accidents, absenteeism, and the psychological state.

A study among workers of the Lockheed Aircraft Corporation, Burbank, California, was undertaken in direct response to the Committee's recommendation.

The main procedures, which taken together comprised the Study, were as follows:

1. Taking and analysis of the diet history of every subject.
2. Medical history and physical examination by clinical and laboratory methods with special reference to nutritional status.
3. Daily administration of a vitamin supplement to one group of subjects and of a placebo to a control group for a period of one year.
4. The selection, for appraisal of psychotherapeutic effects, of a second control group, which received neither supplement nor placebo.
5. Taking and analysis of diet histories a year after the first.
6. A second medical history and examination by clinical and laboratory methods at the end of the Study.

All the subjects were white males, who volunteered from every major department in the plant. The great majority of them worked on the swing shift (4:00 P.M. to 12:30 A.M.); but some office workers and members of the supervisory staff, from all three shifts, also volunteered. In all, 1,173 men were examined.

The initial examinations of the subjects began in November 1941 and ended in February 1942. The reexamination of the 595 men remaining in the Study began in December 1942 and was completed by mid-March 1943. As referred to hereafter, the Study year covers the period March 1, 1942-February 28, 1943.

Reports have been published on the findings resulting from the first two procedures (1,2). The contents of the present report are described above. A fourth and final report will compare the findings on the second physical examinations with those on the first, and present the findings on the incidence of injuries and illness. The final report will conclude with comment on the Study viewed as a whole.

2. CHARACTERISTICS OF THE SUBJECTS IN THE STUDY AND THEIR
RELATION TO THE EFFECT REASONABLY TO BE EXPECTED
FROM THE VITAMIN SUPPLEMENT

The subjects in the Study were a highly selected group of young men exceptionally interested in their work. They were highly selected because they had passed a preemployment medical and psychological aptitude examination, and their health and their psychological aptitude were important points in their selection for employment. The factor of selection was real because, at the time these men sought employment, the labor supply exceeded the demand; accordingly, selection standards were high.

Most of the workers were young men. Over 70 per cent were under 30 years of age at the beginning of the Study. Approximately 44 per cent were single, 54 per cent married, and 1 per cent divorced. Of the total number married, 43 per cent had no children, 30 per cent had one child, 17 per cent two children, and 10 per cent more than two children.

The subjects were exceptionally interested in their work. Thirty-one per cent of them, during the year before the Study began, had come from other states to work in the aircraft industry, an industry with an especial appeal to young men.

Two items of evidence taken from data in the sections which follow show the superiority of the Study group. Their rates of absenteeism and of turnover were relatively low compared with the rate for the aircraft industry in southern California during 1942-1943. The rates of absenteeism in the Placebo and Vitamin groups in the Study were 4.4 and 4.0 days absent per 100 working days during the Study year. A representative figure for the whole aircraft industry in southern California, during 1942-1943, is about 7.0 (3). The annual turnover rate (excluding military terminations) for one of the groups was 18 per cent, for the other 24 per cent. The "quit" rate (i.e., nonmilitary terminations plus dismissals) for

the aircraft industry during the same period was 47 per cent (4).

This comparison of the subjects in the Study with the general industrial population in the aircraft industry in the region demonstrates the initial superiority of the Study group in the above two respects; accordingly they were nearer to the highest level possible of attainment. A great effect of the vitamin supplement on absenteeism and turnover and, by inference, on other aspects of industrial performance was, therefore, not to be expected.

The first examination revealed no acute or severe nutritional deficiency diseases. Consequently there was no opportunity for the dramatic results which undoubtedly would have occurred had there been a relatively high incidence of such diseases.

Another consideration to be borne in mind in appraising the effects of the placebo and of the vitamin supplement is that the Placebo and Vitamin groups were composed of men who volunteered for the Study. They may be presumed to be men who are consciously desirous of improving their health, with initiative (they acted on an opportunity to do something about it), and of a cooperative frame of mind. These traits are not present in all workers; and in those who possess them, they make for better industrial morale.

There is in addition a general consideration, to which much weight is given in industrial practice, to be taken into account in anticipating or appraising the effects of any single welfare measure; namely, the multiplicity of factors which affect absenteeism, turnover, and work performance in general. Even among those which are known, some of the most important factors are beyond the control or even influence of either employer or employee. Those responsible for personnel relations in industry do not, therefore, demand a very great improvement from any single ameliorating factor even from those as persuasive and direct as pay increases, introduction of rest periods, and improved eating facilities. What is hoped for is a worth while over-all result from the accumulation of the small effects of many factors in a welfare program. Only a small effect can be ex-

pected from a factor operating as indirectly as the giving of vitamins to a relatively superior group, neither severely malnourished nor undernourished; especially as, for the great majority, the work was not heavy and there were no hazards such as high temperature, very high or very low humidity, or exposure to toxic chemicals.

On the other hand, if a statistically significant benefit of the vitamin supplement, even though small in absolute terms, was observed in this superior group of industrial workers whose work was not particularly strenuous or hazardous, one may reasonably expect similar or larger benefits in the general industrial population, and especially where the work is strenuous or hazardous and the prevailing diet is less adequate than in our Study group.

3. THE NATURE OF VITAMIN SUPPLEMENT AND PLACEBO

The formula for the nutritional supplement, consisting of vitamins and calcium in tablets and capsules, was prescribed by the Committee on the Nutrition of Industrial Workers of the National Research Council. Its composition was as follows:

Vitamin A (from fish liver oil)	50,000 I.U.
Vitamin D (from fish liver oil)	800 I.U.
Vitamin B ₁ (synthetic)	10 mg.
Vitamin B ₂ (synthetic)	10 mg.
Niacinamide (synthetic)	100 mg.
Ascorbic Acid (synthetic)	250 mg.
Calcium (Ca CO ₃)	500 mg.

These amounts of vitamins and calcium, divided into two equal doses, were given five days a week for a period of one year. The recipients of the vitamin-mineral supplement are designated the Vitamin group.

The placebo was given the men exactly as the supplement; it consisted of sodium bicarbonate in tablets, with coloring added to one of them to simulate riboflavin, and of corn oil in capsules to simulate those containing vitamin A and D. The placebo tablets and capsules were identical in appearance with those containing the nutritional

supplement. The secret of the placebo was well kept. Discreet questioning at the end of the Study failed to reveal a single worker who had discovered it. Those who received the placebo are designated the Placebo group.

Both supplement and placebo were given the men at their places of work by a group of dispensers whose duty it was to locate every subject assigned to them for service. The dispensers carried the tablets and capsules in paper cups. It was the duty of each to observe his subjects swallow, with the aid of a cup of water, what had been given them. Then the dispenser recorded on a card that the supplement had been given.*

Volunteers for the Study were men working on the swing shift. They were employed in all the major departments of the plant. As they reported for their first physical examinations, they were assigned alternately either to the Vitamin or to the Placebo group. Feeding of the full vitamin supplement, as described above, began March 1, 1942 and continued throughout the Study year.

4. CLASSIFICATION OF SUBJECTS FOR PURPOSES OF THIS REPORT

Accurate observation of the effect of a vitamin supplement upon absenteeism, turnover, and Merit Review scores demands the comparison of homogeneous populations. In order to obtain the necessary homogeneity in the groups compared, we have confined ourselves in the present report to those employed on direct production.⁴

* Some men, because they transferred to other plants, departments, and shifts, became inaccessible for daily service by the dispensers. These men were saved to the Study because they called at the office weekly for a five-day supply of vitamins or placebo. We have evidence that the men in the Vitamin group took their supplement in that their blood ascorbic acid values in the second physical examination were so high. By inference, the placebo also was taken regularly.

⁴ Men of supervisory rank are excluded from this report for several reasons. The different ranks of supervisors are not comparable with one another. The criteria in their Merit Review scores differ from those used for production workers. The number was relatively small, and they were not evenly divided between the Placebo and Vitamin groups. Moreover, because they are a more highly selected class than men working on direct production and as a direct consequence of their responsibility, men with supervisory responsibility tend to have markedly fewer absences, to be absent for different reasons, and to have a much lower rate of turnover than the rank and file of direct production workers. A final reason

(Continued on page 120)

In addition, changes in work shift during the Study of a considerable number of subjects made it desirable to subdivide them according to whether they remained on the swing shift or were transferred to the day or graveyard shift.

During the course of the Study many subjects were lost through termination of employment, transfer to other shifts and departments, and (a very few) through loss of interest. Since the objective of the Study was to evaluate the effects of a vitamin-mineral supplement, it was considered necessary to allow some period of time before the therapeutic effects would be manifested in performance, and to select some minimum observation period after therapy might become effective.* Therefore, it was decided to base the comparisons of the Vitamin and Placebo groups with respects to absenteeism and the Merit Review scores on those men who continued to receive vitamins or placebos for at least the first nine months of the Study.

There were 528 men who remained in the Study until December 1, 1942 (a period of nine months) or to a later date. These were equally divided between the Vitamin and Placebo groups. These groups differed somewhat in the proportions who continued on the swing shift and who remained in the Study and on production work for the entire twelve months. In the following tabulations, four subgroups of the above Placebo and Vitamin subjects are used, as follows:

(1) Subjects in the Study for twelve months who remained on the swing shift and on direct production throughout this period. This class is designated "Throughout" Class, Swing Shift.

(2) A composite class designated "Whole" Class, Swing Shift, consisting of the following: (a) the "Throughout" Class, Swing Shift; (b) subjects in the Study for more than nine months on the swing shift and on direct production, who terminated their employment before the end of the Study year, i.e., in the last quarter. Their absenteeism records

for excluding men of supervisory rank is to confine this report to men engaged in physical work all their working time. For this last reason the few clerical workers were excluded also.

* This is discussed in greater detail in the next section.

were included to the end of the last full calendar month of their employment, i.e., their records for the month in which they terminated were excluded; (c) subjects employed for twelve months who remained on the swing shift and on direct production throughout this period, but who left the Study in the last quarter because of transfer to other plants or departments where they could not be served by the dispensers, and did not call for a weekly supply of vitamins or placebos. Their records are included for the whole twelve months of the Study year because it was felt that they had been receiving the vitamin supplement or placebo for so long that it was reasonable to expect the effects to persist for so short a remainder of the Study year; (d) men who changed to work other than direct production, e.g., promotion to supervisor or change to clerical work. Their records were included to the end of the last calendar month they were on direct production, although this period may have been less than nine months;* and (e) subjects who toward the end of the Study year returned to direct production from supervisory or clerical work. These men were in the Study for twelve months and were on the swing shift during their period of production work. Their records were included from the first full calendar month they were on direct production.

(3) Subjects in the Study for twelve months and on direct production throughout this period, who had a change of work shift at any time during the Study year. This class is designated "Throughout" Class, Day and Graveyard Shifts.

(4) A "Whole" Class, Day and Graveyard Shifts similar in composition to class 2 above except that these men had a change in work shift during the Study year.

One other group of direct production workers has been composed and is designated *Terminees*. This group consists of subjects who remained in the Study for less than nine months. Most of these were lost to the Study because they terminated their employment; a smaller number did not call for a weekly supply of vitamins or placebos after they were transferred to other plants, departments,

*As stated in footnote 4, supervisors of all ranks had less absenteeism than production workers. Inclusion of absenteeism records after promotion to supervisory rank would tend to reduce rates of absenteeism, especially in the second half of the year. Since there were more promotions in the Vitamin group than in the Placebo group, the effect of the factor of promotions on any differences in absence rates has been eliminated.

or shifts where they could not be served by the dispensers. Most of the losses in the Terminees class occurred in the first six months of the Study year. As by far the great majority were working on the swing shift at the time they were lost to the Study, and the number who transferred to other shifts were too few for statistical purposes, the Terminees were not subdivided into swing and day and graveyard shift classes. The records of the Terminees were counted through the last full calendar month they remained in the Study.

Very early in the Study several men in the Placebo group reported improvement in health, which they ascribed to the vitamins they were taking. A questionnaire circulated among both the Vitamin and Placebo groups, after the supplement and placebo had been distributed for about two months, showed that a psychotherapeutic effect was widely felt.

In order to appraise the psychotherapeutic effect *per se* a second control group was added, composed of men who did not participate in the Study in any way, and whose characteristics matched those of the two other groups at the end of the Study. The decision to wait until the end of the Study was made because the Study was under way when the psychotherapeutic effect was first discovered; and we could not anticipate what changes would occur by the end of the Study year in such characteristics of the Vitamin and Placebo groups as age, duration of employment, and type of employment.

Mr. L. Stockford, Analyst of the Lockheed-Vega Aircraft Corporation, selected the men who comprise the nonparticipating second control group. It was selected from men who were employed on the swing shift throughout the period of the Study, and matched with the final composition of the Vitamin and Placebo groups with respect to age, duration of employment, and type of work. Selection was made solely from Company records, without interviewing any of the men. No subject selected was aware of the fact, and the selection was completed before any of the results of the Study were known or even tabulated.

The second control group is designed hereafter as the C group. It is comparable to the "Throughout" Class, Swing Shift, of the Placebo and Vitamin groups.

Table 1. Comparison of Control and Vitamin groups at beginning of Study (March 1942) with respect to age, previous duration of employment, and merit rating.

STUDY GROUP	NUMBER IN GROUP	MEAN AGE IN YEARS	MEAN MONTHS EMPLOYED	MERIT REVIEW ¹ SCORE	
				Number	Mean Total Score
<i>All Subjects Remaining in Study² for Nine Months or More</i>					
Placebo Group	264	28.0	12.6	212	33.9
Vitamin Group	264	29.3	14.1	208	33.9
<i>"Throughout" Class, Swing Shift</i>					
C Group	187	29.5	14.4	165	33.8
Placebo Group	166	28.6	11.0	156	34.0
Vitamin Group	138	29.9	12.8	128	34.2
<i>"Whole" Class, Swing Shift</i>					
Placebo Group	208	27.9	12.3	174	33.7
Vitamin Group	198	29.1	14.8	150	33.8
<i>"Throughout" Class, Changed to Day and Graveyard Shifts</i>					
Placebo Group	34	30.2	12.6	31	34.9
Vitamin Group	51	30.9	12.4	47	33.6
<i>"Whole" Class, Changed to Day and and Graveyard Shifts</i>					
Placebo Group	56	28.1	13.7	38	34.7
Vitamin Group	66	29.7	12.1	58	34.0
<i>Terminates, All Shifts³</i>					
Placebo Group	158	25.5	11.3		
Vitamin Group	156	25.8	10.6		

¹ The ratings used were made within two months of March 1, 1942, and were of those men for whom a rating at the end of the Study could be obtained.

² Includes men whose occupational status changed from direct production to supervision or clerical work, and vice versa.

³ Includes all men who were lost to the Study for the following reasons: (a) terminated prior to the last quarter of the Study year, and (b) lost to the Study prior to the last quarter of the Study year because of transfer to departments or shifts where they were inaccessible for service by the dispensers, although they remained employed. The great majority in this group were men who terminated their employment.

5. EVIDENCE FOR THE INITIAL SIMILARITY OF THE TWO CONTROL GROUPS AND THE VITAMIN GROUP

Table 1 compares the three main groups, C, Placebo, and Vitamin, at the time the Study began. This comparison is based upon age, duration of employment, and initial Merit Review scores. With respect to each of these factors, subjects in the Placebo and Vitamin groups who remained in the Study for nine months or more are very similar. The figures show that this conclusion is valid also in the triple comparison of the C group and the "Throughout" Class, Swing Shift subgroups of the Placebo and the Vitamin groups. The small differences in age, duration of employment, and initial Merit Review scores⁷ were not correlated with differences in performance.

The initial comparability of the Placebo and Vitamin groups is further supported by the closely similar initial rates of absenteeism and turnover shown in later sections.

We are justified, therefore, in ascribing to the experimental variants any differences which appeared later.⁸

Table 1 shows that the Terminatee groups were younger and tended to have a shorter period of employment before March 1942 than those who remained in the Study for nine months or more.

6. DIET HISTORIES

Diet histories included as a part of the final examination of subjects were taken and analyzed by the methods used by Wiehl (1) for the diet histories taken at the beginning of the Study. Tables 2, 3, and 4 contain the summarized findings and comparisons with those a year earlier.

⁷ Later sections show that the small initial differences are not statistically significant.

⁸ On the assumption, of course, that the only variants in the three groups were those introduced experimentally, which as far as we know was the case, except for change in shift, termination of employment, promotion from direct production to supervision or demotion, and change from direct production to clerical work. These changes have been taken into account by the classification explained above in Section 2.

FOOD GROUP	RATING ¹	DEC. 1942-MARCH 1943		Nov. 1941-FEB. 1942
		Per Cent of Total in Group		Per Cent of Total Subjects
		Placebo Group	Vitamin Group	
Milk	A	64	60	51
	B	12	18	16
	C	24	22	33
Vegetables	A	15	11	21
	B	22	15	23
	C	63	75	56
Citrus Fruit and Tomatoes; Whole Fruit and Juices	A	34	34	36
	B	22	19	15
	C	44	47	49
Eggs	A	73	60	59
	B	14	16	18
	C	13	24	23
Meat	A	81	77	95
	B	11	19	4
	C	7	4	1

¹ A is satisfactory, B is marginal, and C unsatisfactory. See Footnote p.

Table 2. Percentage distributions of weekly diets according to the qualitative rating for each of five food groups.

The data in these tables show that the quality^o of the diets of

^oDiets were classified as: satisfactory (A), marginal (B), and unsatisfactory (C) for each of five food groups, as follows:

Milk: A — 10 or more glasses

B — 6-9 glasses

C — 5 or less glasses

Vegetables: A — 6 or more servings of green or yellow vegetables

B — 4 or more servings of green or yellow vegetables, and at least 7 of all kinds

C — 3 or less servings of green or yellow vegetables, or less than 7 total with 4 or 5 green or yellow vegetables

Citrus Fruit and Tomato: A — 7 or more

B — 5 or 6

C — 4 or less

Eggs: A — 4 or more

B — 2 or 3

C — 1 or 0

Lean Meat, Fish, or Poultry: A — 5 or more times

B — 3 or 4

C — 2 or less

GENERAL RATING ¹	DEC. 1942-MARCH 1943		Nov. 1941-FEB. 1942
	Per Cent of Total in Group		Per Cent of Total —All Subjects
	Placebo Group	Vitamin Group	
<i>Satisfactory: A</i>	1.6	5.6	2.1
<i>Marginal: B</i>	13.2	7.9	11.2
1 Food Group	4.8	5.1	6.3
2 Food Group	5.8	1.7	3.9
3 Food Group	2.1	1.1	0.8
4 Food Group	0.5	0	0.5
<i>Unsatisfactory: C</i>	85.3	86.4	86.5
1 Food Group	37.6	29.9	32.3
2 Food Group	30.7	35.0	35.8
3 Food Group	13.8	16.4	15.6
4 Food Group	3.2	4.5	2.8
5 Food Group	0	0.6	0

¹ The general rating is the lowest qualitative rating for one or more of the five food groups. See Footnote 9 for the basis of the rating in each food group.

Table 3. Percentage distribution of weekly diets according to lowest qualitative rating for any of the five food groups.

subjects in the Placebo and Vitamin groups was very similar in the winter of 1942-1943. In both groups the distributions of diets accord-

Table 4. Percentage distribution of two-day diet histories according to daily intake of calories.

DAILY INTAKE OF CALORIES	DEC. 1942-MARCH 1943		Nov. 1941-FEB. 1942
	Per Cent of Total in Group		Per Cent of Total —All Subjects
	Placebo Group	Vitamin Group	
Less Than 1,800	2.2	3.3	8.8
1,800-2,199	8.4	4.7	17.6
2,200-2,599	14.6	17.4	20.0
2,600-2,999	20.8	27.0	20.0
3,000-3,399	20.8	24.0	17.6
3,400-3,799	9.6	13.0	9.2
3,800-4,199	15.2	4.0	2.8
4,200-4,599	2.2	3.3	2.4
4,600 or More	6.2	3.3	1.6

ing to qualitative ratings are essentially the same as for the total subjects in the winter of 1941-1942. The slightly lower consumption of meat in the second period, compared with that a year earlier, probably was because the meat supply was temporarily restricted during the winter of 1942-1943. The dietary histories indicate that the food habits of both groups remained essentially unchanged during the Study year. It is reasonable to infer that the nonparticipating control group had similar diets.

PART II

The sections which follow present the findings for the Study year with respect to absenteeism, termination rates, and Merit Review scores. All the data were obtained from Company records. The accuracy of the transcription was verified by a second transcription of the original data, followed by correction of discrepancies between the two transcriptions.

1. ABSENTEEISM

Absenteeism during the Study year is presented for two periods, the first and second six months. It is reasonable to expect that any effect of the vitamin-mineral supplement on absenteeism would become manifest only after some period of therapy and that, whatever the time delay in the appearance of any results, the effects would tend to cumulate and should become more measurable in the latter part of the experimental period.

Rates of absenteeism are expressed as days absent per 100 working man days,³⁰ that is, the per cent of total working days lost because of absences.

³⁰ The number of days absent and the number of working days within a given period are computed for each man, and these are summated for all men in a specified group. (Authorized vacations with pay, five days for most men and ten days for a very few, were not included in the number of working days.) From these totals, a per cent or absence rate per 100 days, is readily calculated. The advantage of this rate is that working periods of different durations can be combined, and the absentee records for men in the Study only

(Continued on page 128)

Two main comparisons made are: (a) between the Placebo and Vitamin groups to examine the possible therapeutic effect of the Vitamin supplement on absenteeism; and (b) between the C (non-participating control) group and the Placebo and Vitamin groups, to observe the psychotherapeutic effect of the placebo and the vitamin supplement on absenteeism.

The data for each of the above comparisons are treated in two ways: differences in rates of total absences; and differences broken down according to cause.

A. COMPARISON OF ABSENCE RATES OF THE PLACEBO AND VITAMIN GROUPS

Absence Rates from all Causes. Rates of total absences in the first half and second half of the Study year are compared in Table 5 for the Placebo and Vitamin groups. Differences between rates for each Placebo and Vitamin group in each six-month period are given in Table 6, together with the statistical probabilities of the occurrence of these differences.

For the total Study population, designated "Whole" Class, All Shifts, Table 5 shows that in the first six months the absence rates were practically the same in both groups (Vitamin group 105 per cent of the Placebo group). In the second six months, the rate for the Placebo group increased to 120 per cent of its first six months' rate; the rate for the Vitamin group decreased to 93 per cent. In the Placebo group there was the usual fall and winter increase in absenteeism; in the Vitamin group the seasonal influence was counteracted.

The difference between the Placebo and Vitamin groups in the first six months is not statistically significant.

part of a given six months can be added to those for subjects who were employed the full period. All rates are directly comparable since they are expressed in the same unit of 100 days. The numbers of days on which men were supposed to work were not identical for the two six-months periods (131 and 128 days for the first and second six months, respectively) and the average numbers of days absent *per man* (or *per capita* for a specified period) would not be comparable for the two periods, even though all persons were in the Study for the full period. The absence rate per 100 working days can be converted to an average rate per person for any desired period by multiplying the rate by the ratio of the number of days in the desired period to 100.

In the second six months, the absence rate for the Vitamin group was 19 per cent lower than that for the Placebo group. As shown in Table 6, the rate for the Vitamin group was 0.89 days per 100 working days less than the rate for the Placebo group, a difference that is highly significant in a statistical sense,²¹ since the chances of its occurrence from random sampling are less than one in a million. For the full six months of 128 days, this is equivalent to a difference of 1.14 days per man.

The same initial similarity and subsequent lesser absenteeism in the Vitamin group occurred consistently in all the subgroups of the Placebo and Vitamin groups. In every comparable pair of subgroups the Vitamin subgroup had the higher rate in the first six months and the lower rate in the second six months. None of the differences in the first six months are statistically significant, and all, except one, in the second six months are significant.

The exception is in the "Throughout" Class, Swing Shift. This subgroup had the lowest absenteeism in the second six months. It

²¹ The probability (P) for a difference in absence rates was obtained from the ratio of the difference to the standard error of the difference $\left(\frac{D}{\sigma_d}\right)$. The standard error of the difference was calculated as follows:

$$\sigma_d = 100 \sqrt{pq \left(\frac{1}{N_1} + \frac{1}{N_2} \right)}$$

$$p = \frac{\text{Total days absent in both groups}}{\text{Total number of working days in both groups}}$$

$$q = 1 - p$$

N_1 and N_2 are the numbers of working days in each of the two groups compared
P for any ratio $\left(\frac{D}{\sigma_d}\right)$ is obtained from a table giving the proportion of the area

under a normal curve in terms of the standard deviation.

The meaning of the estimated statistical probability may be briefly explained as follows: it measures the chances that a difference of the observed magnitude or larger would occur if the two groups compared were independent samples drawn at random from a homogeneous population, that is, if the two samples were affected only by the same sources of variation. A convention generally accepted is that a difference is statistically significant when the probability (P) is .05 or less, that is, when the chances are not more than five in one hundred that a difference equal to or greater than the observed difference would arise as the result of random factors. The smaller the probability the greater is the likelihood that the groups compared are *not* samples from the same universe. Interpretation of the cause of a significant difference must rest on other evidence of sources of dissimilarity between the groups compared. In the present Study, so far as could be determined, the Placebo and Vitamin groups differed only with respect to the experimental therapy.

was industrially the most stable subgroup, composed of men who did not terminate their employment and remained on direct production on the same shift for the whole Study year. Terminations and transfers to other shifts operated as selective influences on the initial groups, so that at the end of the year the men who were still employed and on the swing shift (considered the least desirable shift) were those who were best adjusted and most satisfied with their jobs. It was to be expected that the least differences would occur in this subgroup because only a small effect of a vitamin

Table 5. Total absence rates of Placebo and Vitamin Groups.

GROUP	DAYS ABSENT PER 100 MAN DAYS		RATIO TO RATE OF PLACEBO GROUP X 100		RATIO OF RATE OF SECOND TO FIRST SIX MONTHS X 100	NUMBER OF WORKING MAN DAYS		NUMBER OF DAYS ABSENT	
	First Six Months	Second Six Months	First Six Months	Second Six Months		First Six Months	Second Six Months	First Six Months	Second Six Months
"Whole" Class, All Shifts									
Placebo	3.988	4.791	100	100	120	32,551	29,511	1,298	1,414
Vitamin	4.173	3.899	105	81	93	32,063	28,728	1,338	1,120
"Whole" Class, Swing Shift									
Placebo	3.863	4.312	100	100	112	25,911	23,704	1,001	1,021
Vitamin	3.908	3.722	101	86	95	23,671	20,661	925	769
"Whole" Class, Day and Graveyard Shifts									
Placebo	4.473	6.750	100	100	151	6,640	5,807	297	392
Vitamin	4.921	4.351	110	64	88	8,392	8,067	413	351
"Throughout" Class, Swing Shift									
Placebo	3.832	3.973	100	100	104	21,243	20,991	814	834
Vitamin	3.979	3.662	104	92	92	17,567	17,451	699	639
"Throughout" Class, Day and Graveyard Shifts									
Placebo	4.017	6.411	100	100	160	4,332	4,305	174	276
Vitamin	4.754	3.695	118	58	78	6,500	6,469	309	239

supplement or of any other welfare measure could be expected in industrially the most stable subgroup of a population of superior workers (Part I, Section 2). Although the difference in this subgroup is not statistically significant (P is 0.11), there was a definite trend toward less absenteeism for the Vitamin subjects, consistent with but not of equal magnitude to that shown for the other subgroups.

The converse effect, i.e., the influence of instability in an industrial group on its rate of absenteeism may be construed from the higher rates of absenteeism on the day and graveyard shift subgroups. At the beginning of the Study all of these men were working on the swing shift. The fact that they were transferred to the day and graveyard shifts (two-thirds to the day shift) is evidence that they were discontented on the swing shift, because the Company discouraged transfer from one shift to another, and a transfer

Table 6. Differences between total absence rates of total Placebo and Vitamin groups and of subgroups.

CLASS COMPARED (Placebo-Vitamin)	DIFFERENCE (P-V) DAYS PER 100 MAN DAYS	STANDARD ERROR OF DIFFERENCE	P ¹	DIFFERENCE (P-V) DAYS PER 100 MAN DAYS	STANDARD ERROR OF DIFFERENCE	P ¹
	FIRST SIX MONTHS			SECOND SIX MONTHS		
"Whole" Class, All Shifts	-0.185	0.156	>0.20	+0.892	0.169	<0.001
"Whole" Class, Swing Shift	-0.045	0.174	0.80	+0.590	0.187	<0.01
"Whole" Class, Day and Graveyard Shifts	-0.448	0.348	0.20	+2.399	0.387	<0.001
"Throughout" Class, Swing Shift	-0.147	0.197	>0.40	+0.311	0.197	>0.10
"Throughout" Class, Day and Graveyard Shifts	-0.737	0.405	<0.07	+2.716	0.410	<0.001

¹ P gives the probability with which differences equal to or exceeding those observed might arise through chance, see Footnote II. Values of P above 0.10 are rounded off to the nearest lower 0.10; thus, >0.10 denotes a probability greater than 0.10 but less than 0.20; values between 0.10 and 0.01 are rounded to the next higher 0.01 value, thus, <0.06 denotes a P less than 0.06 but greater than 0.05; values between 0.01 and 0.001 are expressed as <0.01; and all values below 0.001 are expressed as <0.001.

was gained usually only after some persistence. This discontent, as a working hypothesis, may be considered as an element of "strain." The "strain" was present in the individuals and is not to be construed as a result or reflection of differences in working conditions or environment, as it is unlikely that work on the day shift *per se* is a greater strain than on the swing shift.

The "strain" was reflected in the higher rates of absenteeism in the first six months in both the Placebo and Vitamin day and graveyard subgroups than in the corresponding swing shift subgroups, and in the much greater increase in absenteeism in the second six months in the Placebo day and graveyard subgroups than in the corresponding Placebo swing shift groups. On the other hand, in the Vitamin subgroups, the rates decreased in the second six months to not far from those of the Vitamin swing shift subgroups,²² suggesting that the vitamin supplement relieved the "strain," and that the placebo did not.

The findings are in accord with those of Williams, *et al.* (5) that it was in the men in which there was evidence of greater "strain" that the administration of the vitamin supplement was followed by a greater reduction in absenteeism.

Absenteeism Rates According to Reported Cause. Absence rates were classified according to cause as noted in the Company records in order to gain some insight into the reasons for the differences observed in the total absenteeism rates. In the Company records absences are divided into three main categories, as follows:

1. Unauthorized absence:²³

An absence is so classified unless an employee offers an acceptable excuse within the first three hours of the shift on which he works. The

²² The time of year in which transfer to the day and graveyard shift occurred was nearly the same in the Placebo and Vitamin groups. In the "Throughout" Class of the Placebo group, 40 per cent of the transfers occurred in the first six months of the Study year; in the Vitamin group 46 per cent. In the "Whole" classes, 50 per cent of the transfers occurred in the first six months in both the Placebo and Vitamin groups.

²³ This category includes absences on those statutory holidays when employees were expected to work: Labor Day, Thanksgiving, and New Year's Day, and an extra day off before or after Christmas.

great majority of absentees so classed failed even to give notice. Thus, Unauthorized absences reflect directly the attitude of the employe to his job.

2. Absences on account of illness or injury (occupational and non-occupational):

The Company verifies such absences only when they extend beyond three consecutive working days. There is reason to believe that some unverified absences in this category were not due to illness or injury.

3. Authorized absences:

The Company "authorized" absences for such reasons as follows: illness or death in the family, failure of transportation, appearance in court or before a draft board, and an extra vacation of five working days (without pay). Of the total absences in this category, extended vacations accounted for 54 to 76 per cent in the first six months and 43 to 73 per cent in the second six months.

The data on rates of total absences are objective facts; no assumptions of interpretation are introduced. The rates of absenteeism segregated into its causes are less reliable, for not all the alleged reasons for absences were checked. The figures given for Unauthorized absences are minimal figures. If the alleged causes for all absences in the other two categories had been checked, the Illness and Authorized absences probably would have been reduced and the Unauthorized absences increased.

Tables 7 and 8 present the data on absences classified according to cause.

For the total populations of the Placebo and Vitamin groups, it is seen that in the first six months the rates for every cause were slightly, but not significantly, lower in the Placebo group. In the second six months the rates were lower for every cause in the Vitamin group and the differences, except that of illness, were statistically very significant, the probabilities (P) of both differences being less than 0.001. The probability of the difference for illness is 0.08, which is near the conventional borderline between "significant" and "not significant."

A clearer indication of the type of absence which contributes

Table 7. Absence rates of Placebo and Vitamin groups classified according to cause.

GROUP	FIRST SIX MONTHS				SECOND SIX MONTHS			
	All Absences	Unau- thorized	Illness	Author- ized	All Absences	Unau- thorized	Illness	Author- ized
DAYS ABSENT PER 100 MAN DAYS								
"Whole" Class, All Shifts								
Placebo	3.988	0.482	2.114	1.392	4.791	1.755	2.192	0.844
Vitamin	4.173	0.493	2.246	1.435	3.899	1.351	1.984	0.564
"Whole" Class, Swing Shift								
Placebo	3.863	0.401	1.941	1.521	4.312	1.569	2.017	0.726
Vitamin	3.908	0.448	1.994	1.466	3.722	1.244	1.955	0.523
"Whole" Class, Day and Graveyard Shifts								
Placebo	4.473	0.798	2.786	0.889	6.750	2.514	2.910	1.326
Vitamin	4.921	0.620	2.955	1.347	4.351	1.624	2.058	0.669
"Throughout" Class, Swing Shift								
Placebo	3.832	0.391	1.916	1.525	3.973	1.491	1.887	0.595
Vitamin	3.979	0.461	2.135	1.383	3.662	1.192	1.920	0.550
"Throughout" Class, Day and Graveyard Shifts								
Placebo	4.017	0.854	2.516	0.646	6.411	2.602	2.532	1.278
Vitamin	4.754	0.646	2.954	1.154	3.695	1.469	1.855	0.371
NUMBER OF DAYS ABSENT								
"Whole" Class, All Shifts								
Placebo	1,298	157	688	453	1,414	518	647	249
Vitamin	1,338	158	720	460	1,120	388	570	161
"Whole" Class, Swing Shift								
Placebo	1,001	104	503	394	1,022	372	478	172
Vitamin	925	106	472	347	769	257	404	108
"Whole" Class, Day and Graveyard Shifts								
Placebo	297	53	185	59	392	146	169	77
Vitamin	413	52	248	113	351	131	166	54
"Throughout" Class, Swing Shift								
Placebo	814	83	407	324	834	313	396	125
Vitamin	699	81	375	243	639	208	335	96
"Throughout" Class, Day and Graveyard Shifts								
Placebo	174	37	109	28	276	112	109	55
Vitamin	309	42	192	75	239	95	120	24

most to the total reduction in absenteeism in the second six months is gained if attention is directed to the absolute differences in rates for each cause. The greatest contributor to the total difference was

Table 8. Differences between Placebo and Vitamin groups in rates of absence due to different causes.

CLASS COMPARED (PLACEBO-VITAMIN)	UNAUTHORIZED			ILLNESS			AUTHORIZED		
	Difference		P ¹	Difference		P ¹	Difference		P ¹
	Days Per 100 Man Days	Stand- ard Error		Days Per 100 Man Days	Stand- ard Error		Days Per 100 Man Days	Stand- ard Error	
	FIRST SIX MONTHS								
"Whole" Class, All Shifts	-0.011	0.055	>0.80	-0.132	0.115	>0.20	-0.043	0.093	>0.60
"Whole" Class, Swing Shift	-0.047	0.058	>0.40	-0.053	0.125	>0.60	+0.055	0.109	>0.60
"Whole" Class, Day and Graveyard Shifts	+0.178	0.137	>0.10	-0.169	0.275	>0.50	-0.458	0.175	<0.01
"Throughout" Class, Swing Shift	-0.070	0.066	>0.20	-0.219	0.143	>0.10	+0.142	0.122	>0.20
"Throughout" Class, Day and Graveyard Shifts	+0.208	0.167	>0.20	-0.438	0.322	>0.10	-0.508	0.190	<0.01
	SECOND SIX MONTHS								
"Whole" Class, All Shifts	+0.404	0.103	<0.001	+0.208	0.119	0.08	+0.280	0.069	<0.001
"Whole" Class, Swing Shift	+0.325	0.113	<0.01	+0.062	0.133	>0.60	+0.203	0.075	<0.01
"Whole" Class, Day and Graveyard Shifts	+0.890	0.241	<0.001	+0.852	0.264	<0.01	+0.657	0.166	<0.001
"Throughout" Class, Swing Shift	+0.299	0.118	<0.02	-0.033	0.140	>0.80	+0.045	0.077	>0.50
"Throughout" Class, Day and Graveyard Shifts	+1.133	0.270	<0.001	+0.677	0.284	<0.02	+0.907	0.168	<0.001

¹ See Footnote to Table 6 and Footnote 11.

Unauthorized absences and the least contributor Illness absences. Of the total difference of 0.89 days per 100 days in the second six months, 0.40 is Unauthorized absence, 0.28 Authorized absence, and .21 is Illness absence. In other words, the absences affected most were those which reflect directly the attitude of the employe to his job.

In general, the difference noted for the total groups in the second six months occurred consistently in all the subgroups. In every subgroup the greatest absolute difference between the Placebo and Vitamin groups was in Unauthorized absences, and all the differences in this category are statistically significant. The differences were least in Illness absences, except for the "Whole" Class, Day and Graveyard subgroup. In fact, in the "Throughout" Class, Swing Shift comparison, the Placebo group had a slightly lower rate than the Vitamin group, even in the second six months, but the difference is negligible.

In accord with trends seen in comparisons of total absenteeism for the Placebo and Vitamin subjects in specific subgroups, in the second six months the smallest differences for every cause occurred in the comparison of the "Throughout" Class, Swing Shift, the most stable industrial subgroup, and the largest differences were in the Day and Graveyard Shift subgroups where the element of "strain" was greater. In the latter there were large differences even in Illness absences in the second six months, and differences for all three types of absence were statistically significant. For the "Throughout" Class, Swing Shift subgroup, only the difference for Unauthorized absences is significant.

In the foregoing discussion little weight was given the findings on Authorized absences. This category is a miscellaneous one, and difficult to interpret. It includes some absences which would have been classified as Unauthorized had it been possible to verify the reasons given for absence. The largest single element, accounting for more than 50 per cent in this category, is an authorized five-day

extension of a vacation, but without pay. When extended vacations are subtracted, the remainder (smaller in the Vitamin subgroups in both six-month periods) is quite small in absolute terms, and the difference in it between the two groups makes an unimportant contribution to the difference in total absence rates in the second six months.

**B. ABSENCE RATES OF THE NONPARTICIPATING CONTROL GROUP (C)
AND OF THE PLACEBO AND THE VITAMIN GROUPS: THE PSYCHO-
THERAPEUTIC EFFECT ON ABSENTEEISM**

In Part I, Section 4, the construction of a nonparticipating control group (C) was described. The purpose was to observe differences between the C and the Placebo groups which might be ascribed to the psychotherapeutic effect of the placebo. It must be recognized that the comparison of the C with the Placebo group tests more than the psychotherapeutic effect of the placebo. At least two additional factors are included. One is the effect *per se* of participation in an experiment; the other is the element of selection, in that the subjects of the Placebo and Vitamin groups volunteered for the Study, whereas the subjects of the C group did not. As the present Study afforded no means of segregating the three factors, for convenience, their combined effect will be referred to hereafter as the psychotherapeutic effect.

The C group was selected at the end of the Study to match the subjects of the Placebo and Vitamin groups in the "Throughout" Class, Swing Shift. The only comparisons warranted, therefore, are between the C group and these two subgroups of the population which participated actively in the Study. Table 9 contains the data for these comparisons.

In the first six months the absence rate for all causes was slightly higher in the C group than in the Placebo and Vitamin groups, but statistically the differences are not significant. In the second six months the absence rate in the C group was 1.4 and 1.7 days per 100

days higher than in the Placebo and Vitamin groups, respectively, and both of these differences are very significant statistically.

The interpretation of absenteeism in the C group as compared with the Placebo and Vitamin groups becomes much clearer when differences in absence rates by specific causes are considered. These differences are, therefore, summarized from Table 9. In the first six months the rates of Unauthorized and Illness absences were higher in the C group than in either of the other two groups. The differences in Unauthorized absences are statistically significant; the C-Placebo difference in Illness absences is significant; and the C-Vitamin difference is nearly so ($P=.08$). But the Authorized absence rate was significantly lower in the C group than in the Placebo and Vitamin groups, and very largely offset the higher absenteeism

Table 9. Absence rates of the nonparticipating Control group (C) compared with rates of the Placebo (P) subjects, and of the Vitamin (V) subjects in the "Through-out" Class, Swing Shift.

PERIOD AND CAUSE OF ABSENCE	NUM- BER OF DAYS ABSENT FOR C GROUP ¹	DAYS ABSENT PER 100 MAN DAYS			DIFFERENCE IN RATES					
					C—Placebo			C—Vitamin		
		C	P	V	Days Per 100 Man Days	St. Error	P ²	Days Per 100 Man Days	St. Error	P ²
<i>First Six Months</i>										
Total Absences	974	4.103	3.832	3.979	+0.271	0.185	>0.10	+0.124	0.196	>0.50
Unauthorized	152	0.640	0.391	0.461	+0.249	0.068	<0.001	+0.179	0.075	<0.02
Illness	568	2.393	1.916	2.135	+0.477	0.138	<0.001	+0.258	0.149	<0.09
Authorized	254	1.070	1.525	1.383	-0.455	0.106	<0.001	-0.313	0.109	<0.01
<i>Second Six Months</i>										
Total Absences	1,258	5.338	3.973	3.662	+1.365	0.201	<0.001	+1.676	0.210	<0.001
Unauthorized	355	1.506	1.491	1.192	+0.015	0.115	>0.85	+0.314	0.116	<0.01
Illness	704	2.987	1.887	1.920	+1.100	0.147	<0.001	+1.067	0.157	<0.001
Authorized	199	0.844	0.595	0.550	+0.249	0.081	<0.01	+0.294	0.084	<0.001

¹ For C group the total number of working man days in the first six months is 23,736, and in the second six months it is 23,568. See Table 7 for numbers for the P and V groups.

² Probability of the observed difference occurring by chance. See Footnote to Table 6.

from Unauthorized and Illness absences. In the second six months the rate of Unauthorized absences became nearly the same in the C and Placebo group; the C- Vitamin difference, on the other hand, was nearly double that in the first six months, and the difference is statistically significant. The excess absence rate from illness in the C group became much greater in the second six months. Authorized absences also became significantly higher in the C group than in either of the other groups.

As previously discussed, little weight can be given to differences in Authorized absences. Approved extended vacation absences affected the rates for the different groups to an unequal degree in the first and second six-month periods. If vacation absences are subtracted from total Authorized absence rates, the remainders are: in the first six months, 0.375, 0.701, and 0.336 in the C, Placebo, and Vitamin groups, respectively; in the second six months, 0.483, 0.180, and 0.149 days per 100 days. The miscellaneous nature of the causes of these Authorized absences makes it impossible to interpret differences in rates.

A simple interpretation, and one in accord with general experience, is to ascribe the differences in Unauthorized and Illness absences in the first six months between the C and the two other groups entirely to the psychotherapeutic effect. A psychotherapeutic effect would be expected to manifest itself quite early.²⁴ In the second six months there was practically no difference in rates of Unauthorized absences between the C- Placebo groups; the psychotherapeutic effect on this category of absences had, therefore, worn off. The large difference in Unauthorized absences between the C and Vitamin groups and between the Placebo and Vitamin groups in the second six months may, therefore, be ascribed to a therapeutic effect of the vitamin supplement. This interpretation is strengthened by the fact that the difference between the Placebo and Vita-

²⁴ See discussion on page 137 of the elements which enter into the psychotherapeutic effect.

min groups in Unauthorized absences in the first six months is not statistically significant; the psychotherapeutic effect, presumably, was equal in these two groups.

It would be expected, if the state of well-being of the recipients of the vitamin supplement gradually improved, as compared with the men in the two other groups, that the rate of Unauthorized absences, at first the same in the Vitamin and Placebo groups, would gradually become relatively less in the Vitamin group, while those of the C and Placebo groups would remain more nearly alike. The data are in accord with this hypothesis. It is common clinical experience that one of the earliest manifestations of an inadequate vitamin intake (especially of thiamine) is an impairment of the feeling of well-being. This affects mental attitude in many ways (5,6,7) and in industrial workers would affect attitude toward the job, which reflects itself in the rate of Unauthorized absences more than any other category of absences.

The greater rate of Illness absences in the C than in the other two groups in both the first and second six months is to be ascribed entirely to the psychotherapeutic effect, as there was no difference in this respect between the Placebo and Vitamin groups ("Through-out" Class, Swing Shift) in either the first or second six months. The therapeutic effect of the vitamin supplement on Illness absences manifested itself only in those workers in which there was evidence of "strain" (transferees to the day and graveyard shifts, Tables 7 and 8).

Paradoxical as it may seem at first, this was the result to be expected (in the event of any positive result). The men in the Placebo and Vitamin groups believed they were getting large doses of vitamins, which they expected would benefit their health. In the final medical histories, many in the Placebo group reported improved health and gave the credit to the vitamins they believed they were taking. There were, of course, similar reports from the Vitamin group. The expectation of better health evidently encouraged

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the feeling that this had occurred and this, in turn, tended to reduce absenteeism due to illness in the recipients of the placebo and vitamin supplement.

It would be unwarranted and premature to ascribe the whole of the psychotherapeutic effect to self-delusion. Participation in an experiment concerned with health undoubtedly increases the interest of a subject in his health. It is reasonable that, as a result, he will pay greater attention to and take more care of his health than if his interest in it were not refreshed every day he was at work by his being given what he believed was helping him (placebo or vitamins). It is a commonplace of medical practice that greater interest in health and the better care which follows it are real therapeutic factors.

C. ABSENTEEISM AMONG TERMINEES

Table 10 gives the absenteeism rates of the Terminees. The survey year is divided into the first quarter and the Remainder, and no separation is made of subjects on different shifts because there were

Table 10. Absence rates of Terminees in Placebo and Vitamin Groups, classified according to cause of absence.

GROUP	DAYS ABSENT PER 100 WORKING DAYS				NUMBER OF WORKING DAYS	NUMBER OF DAYS ABSENT			
	All Absences	Unau- thorized	Illness	Author- ized		All Absences	Unau- thorized	Illness	Author- ized
FIRST QUARTER									
Placebo	4.090	0.423	2.641	1.025	8,974	367	38	237	92
Vitamin	3.921	0.366	2.728	0.827	8,467	332	31	231*	70
SECOND AND THIRD QUARTERS									
Placebo	8.922	0.981	4.229	3.712	5,604	500	55	237	208
Vitamin	8.904	1.337	4.330	3.238	5,312	473	71	230	172

too few working man days to warrant division into two six-month periods or into swing, and day and graveyard shifts.

In the first quarter the rates of both the Placebo and Vitamin groups were nearly the same, and were very similar also to those of the other Study groups in the first six months. In the Remainder period, the rates were again nearly the same in both groups of Terminees, but were much higher than the rates for those who remained in the Study nine months or more.

The higher absence rates in the Terminees, as compared with the other groups, occurred in Illness and Authorized absences. The rates of the Terminees in the latter category are so high because the second and third quarters in the Remainder period include the months when most of the extended five-day vacations were taken, whereas in the two six-month periods the vacation months were divided, and also because many men with a short employment period received a vacation before terminating employment.

The high absence rates of the Terminees in the Remainder period is in accord with the general experience that workers who terminate their employment tend, prior to their termination, to have a higher than average rate of absenteeism.

The fact that the rates for Terminees in the Placebo and Vitamin groups were nearly the same in the Remainder period is in accord with the view that at least six months was required for the manifestation of differences in absenteeism between the Placebo and Vitamin groups.

2. INDUSTRIAL TURNOVER

The rate of industrial turnover is determined, of course, by many causes, and the causes vary, depending upon time, place, and type of industry. Before any possible effect of a vitamin supplement upon the rate of industrial turnover can be measured, we must subtract the men who terminated their employment in order to join the armed forces; for obviously only those who terminated for other

MONTH	TERMINATED FOR MILITARY REASONS		TERMINATED FOR NONMILITARY REASONS		LEFT SURVEY BUT REMAINED WITH COMPANY		TOTAL LOST TO SURVEY FOR ALL REASONS	
	P	V	P	V	P	V	P	V
March, 1942	2	8	14	8	1	2	17	18
April, 1942	13	11	11	10	3	2	27	23
May, 1942	11	13	10	9	7	7	28	29
June, 1942	4	3	7	7	5	13	16	23
July, 1942	3	13	5	2	5	7	13	22
August, 1942	10	11	7	6	3	6	20	23
September, 1942	15	10	11	3	4	4	30	17
October, 1942	18	11	7	2	4	4	29	17
November, 1942	6	5	5	4	0	1	11	10
December, 1942	10	9	4	1	2	5	16	15
January, 1943	7	6	1	2	1	3	9	11
February, 1943	7	8	0	2	1	1	8	11
TOTAL	106	108	81	56	36	55	224	219
Total as Per Cent of Number in Survey, March 1, 1942 ¹	24.6	26.4	19.0	13.7	8.4	13.5	52.0	53.5

¹ Number in survey March 1, 1942: Placebo group (P), 431; Vitamin group (V), 409.

Table 11. The number of production workers lost to the survey from March 1, 1942 to February 28, 1943 in the Placebo and Vitamin groups, classified according to three main reasons.

reasons are to be considered for purposes of this Study as industrial turnover.¹⁸

Table 11 gives the numbers, month by month, of production workers who left the Study for whatever reason. Men on all shifts are combined in the analysis of turnover.

It will be noted that more men in the Vitamin group left the Study but remained with the Company than in the Placebo group. A larger number in the Vitamin group were transferred to other shifts during the Study year and among those transferred approxi-

¹⁸ The tables on industrial turnover are based only on men who were production workers throughout their period of employment during the Study year.

MONTH	TERMINATIONS PER 100 PERSONS PER MONTH			CUMULATIVE TERMINATION RATES			DIFFERENCES BETWEEN RATES FOR THE P AND V GROUPS (P-V)	
	Nation- al Rate ¹	P Group	V Group	Nation- al Rate	P Group	V Group	Monthly Rates	Cumulative Rates
March, 1942	3.70	3.25	1.96	3.70	3.25	1.96	1.29	1.29
April, 1942	3.79	2.66	2.56	7.49	5.91	4.52	0.10	1.39
May, 1942	4.06	2.58	2.45	11.55	8.49	6.97	0.13	1.52
June, 1942	3.60	1.95	2.06	15.15	10.44	9.03	-0.11	1.41
July, 1942	3.76	1.46	0.63	18.91	11.90	9.66	0.83	2.24
August, 1942	4.29	2.12	2.04	23.20	14.02	11.70	0.08	2.32
September, 1942	4.72	3.55	1.11	27.92	17.57	12.81	2.44	4.76
October, 1942	4.41	2.50	0.79	32.33	20.07	13.60	1.71	6.47
November, 1942	3.86	1.99	1.69	36.19	22.06	15.29	0.30	6.77
December, 1942	3.40	1.67	0.44	39.59	23.73	15.73	1.23	8.00
January, 1943	3.86	0.45	0.94	43.45	24.18	16.67	-0.49	7.51
February, 1943	3.71	0	1.00	47.16	24.18	17.67	-1.00	6.51

¹ "Quit" rate in whole aircraft industry (nonmilitary terminations plus dismissals) (4).

Table 12. Monthly percentages of persons in the Study at the beginning of a specified month who left the Company in that month for nonmilitary reasons.

mately an equal proportion of the Vitamin and of the Placebo subjects remained in the Study.

Table 12 gives the monthly rates of nonmilitary terminations³⁰ and the "Quit" rate (i.e., nonmilitary terminations plus dismissals) in the whole aircraft industry. The method of computation in Table 12 needs to be explained. The baseline for nonmilitary terminations (i.e., the number of subjects potentially liable to nonmilitary termination), changed each month. This baseline was computed as the total number remaining in the group at the beginning of the month after those leaving the Study and those terminating employment for any reason in the previous months are deducted from the total. The percentage of nonmilitary terminations is computed for each month, and monthly rates may be cumulated to obtain the termination rate for any part or all of the twelve-month period.

³⁰ There was only one dismissal among subjects in the Vitamin group and four dismissals in the Placebo group.

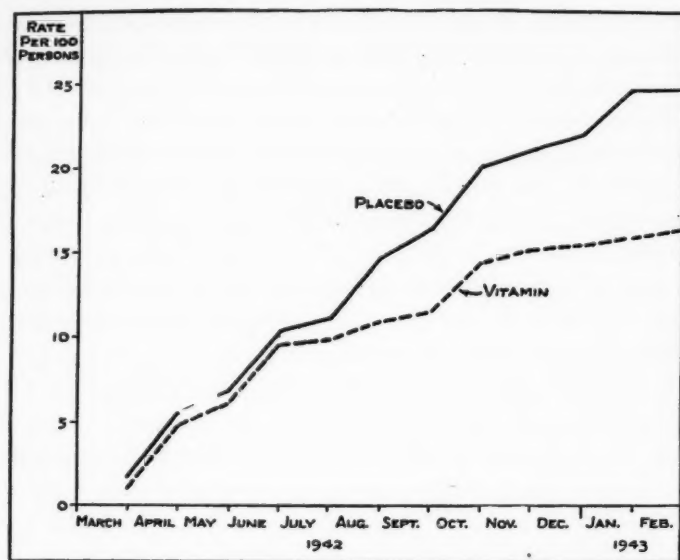


Fig. 1. Nonmilitary terminations in the Placebo and Vitamin groups. Monthly percentages for terminations among employees in Study at beginning of each month cumulated.

Tables 11 and 12 show that the rate of nonmilitary terminations over the period of the whole year was less in the Vitamin group than in the Placebo group, whether computed on the basis of the number in each group on March 1, 1942, or on a cumulative monthly basis. On the latter basis, the annual termination rate for the Placebo group was 24 per cent and for the Vitamin group, 18 per cent.

The difference between the two groups was too small during the first four months (Table 12 and Figure 1) to be significant. It consisted mainly in the difference in the first month, March 1942, which was too short a period for the vitamin supplement to have exerted any manifest influence.

After the first four months the rate in the Placebo group continued essentially unchanged until December (Figure 1). In the

Vitamin group, on the other hand, the rate declined sharply after June to approximately one-half its former value and persisted at this lower rate.

For two related reasons the termination rates in the last quarter are not significant in either group. The total number of nonmilitary terminations was quite small (five in each group), and by the last quarter both groups had become stable with respect to turnover; i.e., by that time nearly all the men who were likely to leave the Company for nonmilitary reasons had done so. It is well known that employees who have been with a company for a long time are less likely to leave than new employees.

By the end of the twelve-month period the cumulative rate of nonmilitary terminations in the Vitamin group was 73.1 per cent of that in the Placebo group. In terms of over-all annual percentages,

Table 13. Differences in military and nonmilitary terminations in the Placebo and Vitamin groups in the first four months and last eight months of the Study year.

TYPE OF TERMINATION, PERIOD OF TERMINATION, AND STUDY GROUP	NUMBER OF EM- PLOYEES ¹	NUMBER OF TER- MINATIONS	TERMI- NATIONS PER 100 EMPLOYEES	DIFFERENCE (P-V)		
				Per 100 Employees	Stand. Error	Proba- bility
<i>Military Terminations</i>						
First Four Months:						
Placebo	409	30	7.33	-1.60	1.93	> 0.40
Vitamin	392	35	8.93			
Last Eight Months:						
Placebo	308	76	24.68	-0.67	3.55	> 0.80
Vitamin	288	73	25.35			
<i>Nonmilitary Terminations²</i>						
First Four Months:						
Placebo	416	42	10.10	+1.38	2.06	> 0.50
Vitamin	390	34	8.72			
Last Eight Months:						
Placebo	297	40	13.47	+5.10	2.66	0.055
Vitamin	263	22	8.37			

¹ The number of employees is the average of the numbers at the beginning of each month in any period after excluding those terminated in previous months for other reasons.

² Termination rates in this table differ slightly from those obtained by cumulating monthly rates shown in Table 12, but the differences are almost identical.

i.e., the total number of nonmilitary terminations during the year divided by the number of those present on March 1, 1942, the rate for the Vitamin group was 71.9 per cent of the rate for the Placebo group.

Table 13 contains the data on the statistical significance of the differences in military and nonmilitary termination rates. The Study year was divided into the first four months and the remaining eight months because, as Figure 1 shows, a sharp difference between the two groups occurred in the middle of the second quarter.

Differences in the rates of military terminations between the Placebo and Vitamin groups are not statistically significant, neither in the first four months nor in the last eight months of the year. Similarly, the difference in rates of nonmilitary terminations in the first four months is not statistically significant. This is additional evidence of the similarity of the Placebo and Vitamin groups at the beginning of the Study.

In the last eight months the rate of nonmilitary terminations in the Vitamin group is 8.4 per cent compared with 13.5 per cent in the Placebo group. The difference (5.1 per cent) has a statistical probability of 0.055, which is a borderline value, indicating that chances are about one in eighteen for the occurrence of such a difference as a result of pure chance.³⁷

The most frequent reasons given for nonmilitary terminations were: the offer of a job elsewhere with more money; dissatisfaction with living conditions causing the men to move to another city; an obligation, usually for family reasons, to return to the home city; and dissatisfaction with the job. The "freezing" order came toward the very end of this Study; therefore it did not operate to reduce nonmilitary terminations. An independent study at the Lockheed Aircraft Corporation showed that reasons given for termination are

³⁷ If the nonmilitary termination rates for the five months July-November are compared, the difference is 5.35 per cent and P for this difference is 0.025.

often only rationalizations, the real reasons being dissatisfaction with the job or failure of adjustment.

A reasonable explanation for the lower rate of nonmilitary termination in the Vitamin group is a better attitude of the men toward the job; i.e., their morale became better. Hence such reasons for leaving the job as alleged above came to be felt as less pressing. This explanation of the findings on termination rates is in accord with that of the findings on absenteeism and, as shown below, with those on the Merit Rating Reviews.

Since the data on turnover concern only the Placebo and Vitamin groups, the psychotherapeutic effect was present in both and is canceled out in comparisons made between them. The only difference, as far as we are aware, in the factors operating on the two groups is the possible therapeutic effect of the vitamin supplement. On the evidence, the greater improvement in morale in the Vitamin group may, therefore, be ascribed to this therapeutic effect.

3. MERIT REVIEW SCORES

(AN INDEX OF INDUSTRIAL MORALE)

The Company's contract with the Union calls for a Merit Review rating on every employe at six-month intervals. Each review, which is made by the employe's immediate superior, attaches a numerical score to each of six characteristics: quality of production, quantity of production, adaptability, knowledge of the job, dependability, and attitude. The lowest score possible for each characteristic is 0, and the highest 8. There are no fractional scores. The lowest individual score given any employe in this survey was 2, in one case. The score on the Merit Rating Review in conjunction with comments about the man are important factors in determining whether he gets a raise, and how much.

All the reviews used in this Study were made routinely without any reference to the Study. Few supervisors of the many who made the reviews even knew which men were in the Study, and none

knew that some men were receiving placebos. The same supervisors made reports on men in all three groups. The closeness of the scores for all three groups in the review made at the beginning of the Study, and for the two control groups in the review made at the end of the Study, show that there were no differences in leniency and severity of rating the three groups.

The reviews in the two months before and two months after March 1, 1942 are designated "Initial" Reviews. "Final" Reviews were made in a similar period bracketing March 1, 1943. Special reviews were made when men left the Company, and these were used if a routine review had not been made during the final four-month period of the Study. The mean scores obtained by men in the Placebo, Vitamin, and C groups and in the subgroups are given in Table 14.

Higher scores were given all three groups in the "Final" Reviews. This may be explained, in part at least, by the assumption that the longer a man works at a given job the more useful he becomes. The consistency of higher scores in the "Final" Reviews reflects also a possible tendency to make scores justify the raises all companies had to give their men in order to keep them during the period of rapid expansion. This must be borne in mind in appraising the data on Merit ratings.

It is clear from Table 14 that the scores for dependability and attitude, in both the "Initial" and "Final" Reviews, tended to be higher than those for the other four characteristics. The attitude scores are consistently slightly higher than those for dependability.

Nearly always, when the score for any one characteristic was low, those for all the others were low, and vice versa for the high scores. A conservative interpretation of the scores given for the various characteristics is that the individual scores are, largely, appraisals of an employee's general reliability and work performance which are reflections of his morale. It is difficult otherwise to account for the

Table 14. Merit Review scores at the beginning and end of the Study year for subjects in the Placebo, Vitamin, and nonparticipating control group.

CLASS AND STUDY GROUP	NUMBER OF SUBJECTS ¹	MEAN SCORE FOR SPECIFIED CHARACTERISTIC						MEAN SCORE FOR ALL RATINGS
		Quality	Quantity	Adaptability	Knowledge	Dependability	Attitude	
"INITIAL" MERIT REVIEWS								
<i>"Whole" Class, All Shifts</i> Placebo Vitamin	212	5.623	5.448	5.623	5.420	5.797	5.991	5.650
	208	5.574	5.442	5.654	5.452	5.760	5.976	5.643
<i>"Whole" Class, Swing Shift</i> Placebo Vitamin	174	5.569	5.431	5.598	5.397	5.787	5.948	5.622
	150	5.547	5.427	5.633	5.447	5.753	5.973	5.630
<i>"Whole" Class, Day and Graveyard Shifts</i> Placebo Vitamin	38	5.868	5.527	5.737	5.527	5.843	6.185	5.781
	58	5.655	5.466	5.707	5.466	5.776	5.983	5.676
<i>"Throughout" Class, Swing Shift</i> C Placebo Vitamin	165	5.612	5.430	5.588	5.455	5.758	5.982	5.638
	156	5.628	5.474	5.635	5.442	5.853	6.000	5.672
	128	5.594	5.500	5.703	5.508	5.789	6.063	5.693
<i>"Throughout" Class, Day and Graveyard</i> Placebo Vitamin	31	5.903	5.548	5.806	5.613	5.903	6.161	5.822
	47	5.596	5.383	5.596	5.383	5.723	5.894	5.596
"FINAL" MERIT REVIEWS								
<i>"Whole" Class, All Shifts</i> Placebo Vitamin	212	6.203	6.071	6.193	6.057	6.288	6.495	6.218
	208	6.447	6.183	6.293	6.332	6.442	6.567	6.377
<i>"Whole" Class, Swing Shift</i> Placebo Vitamin	174	6.259	6.144	6.264	6.121	6.356	6.557	6.284
	150	6.487	6.260	6.387	6.427	6.567	6.647	6.463
<i>"Whole" Class, Day and Graveyard Shifts</i> Placebo Vitamin	38	5.948	5.711	5.843	5.711	5.974	6.236	5.904
	58	6.344	5.983	6.051	6.120	6.189	6.362	6.175
<i>"Throughout" Class, Swing Shift</i> C Placebo Vitamin	165	6.370	6.194	6.273	6.224	6.345	6.466	6.312
	156	6.282	6.205	6.269	6.173	6.385	6.577	6.315
	128	6.570	6.336	6.438	6.453	6.656	6.711	6.527
<i>"Throughout" Class, Day and Graveyard</i> Placebo Vitamin	31	6.032	5.839	5.871	5.742	6.000	6.290	5.962
	47	6.362	5.979	6.043	6.085	6.213	6.340	6.170

¹ Only those men were included for whom ratings as production workers were available at the beginning and at the end of the Study. For example, men who were promoted to supervision or who changed to clerical work were excluded. Since every man was given a Merit rating on the termination of his employment, ratings were available of those who terminated in the last quarter, and they were included.

higher scores in the "Final" Reviews for all characteristics made by the Vitamin group than by the two control groups. The Vitamin group excelled most in "knowledge" and "quality" and also in "adaptability," "quantity," "dependability," and "attitude." The reviewer, having no objective measures or records of a cumulative character on which to base his scores, had to rely mostly upon the impression an employe made upon him. This fact reenforces the interpretation that the scores for each characteristic are not so much specific appraisals of an employe's merit, in these six different respects, as they are of his attitude toward his job which, of course, affects every aspect of his work performance. Accordingly, differences in the group means of the average scores for six characteristics give as much information regarding differences in performance for the three groups, and between the "Initial" and "Final" Reviews, as the differences in the mean scores for the individual characteristics. They may be taken to represent mainly differences in morale. We shall, therefore, confine ourselves in the following discussion mainly to the differences in the group means of the average ratings on six characteristics.

Table 14 shows that the scores in the "Initial" Reviews were very nearly the same in the total populations and in the swing shift subgroups of the Placebo and Vitamin groups. The scores of the non-participating control group and the corresponding Placebo and Vitamin subgroups also were approximately the same. The day and graveyard shift subgroups of the Placebo group had higher "Initial" scores than the corresponding Vitamin subgroups. None of the differences in comparable groups in the "Initial" Reviews are statistically significant³⁸ (Table 15), except that for the "Through-out" Class, Day and Graveyard Shifts.

³⁸ The probability that the observed divergence in means of Merit Review scores for any two Study groups is the result of random variation was estimated by analysis of variance (8). The magnitude of the variation in a distribution of the over-all mean scores for individual employes in any specific group is increased by the fact that the mean scores for each of the six characteristics varied. This variation in mean scores for the different characteristics is

(Continued on page 152)

The picture is quite different in the "Final" Review scores. Every Vitamin subgroup received a higher score for every individual characteristic than the corresponding C group or Placebo subgroup and, of course, a higher mean score. As shown in Table 15, the mean score for the total Vitamin group and for each subgroup differed significantly from the mean score of its corresponding Placebo group. In the comparisons of the mean "Final" score for the non-participating control group (C) with the Study groups, the difference between the C group and the Placebo group is not statistically significant but the C group has a significantly lower score than the Vitamin group.

The consistency of the differences in the "Final" Reviews and their absence in the "Initial" Reviews deserve some emphasis. In their "Initial" Reviews the two swing shift subgroups of the Placebo group received higher scores for individual characteristics in five instances, the corresponding Vitamin subgroups in seven. Among the day and graveyard shift subjects the Placebo subgroups received in their "Initial" Review the higher score in all twelve instances for individual characteristics. In the "Final" Reviews, each Vitamin subgroup received the higher score for every individual characteristic.

The absence of any such reversal in the second six months in the common to subjects in all the Study groups and is independent of any variation associated with membership in a particular Study group; therefore, variation due to this factor should be eliminated in obtaining a valid estimate of the variation among individuals with respect to Merit ratings. By analysis of variance, the total variation in Merit ratings is separated into (1) the variation of individual scores from the mean scores for the respective characteristics and the mean variance from this source is designated in Appendix Table 1 as mean square for "within characteristics"; (2) the variation among mean scores for the different characteristics, for which the variance is shown in Appendix Table 1 as mean square among means of characteristics; (3) the variation between the over-all mean scores for subjects in any two groups compared, for which the variance is shown in the Table as mean square between group means; and (4) a remainder or interaction variance for factors not controlled. For purposes of this Study, we are interested in determining whether any two groups compared are homogeneous or heterogeneous samples with respect to the Merit scores obtained. From the measure of variation among individual scores (mean square "within characteristics"), the probability that any observed difference in group means would occur from random sampling is determined by the ratio of the mean square between group means to the mean square "within characteristics" and this ratio is termed the F value. The probability corresponding to any ratio is taken from statistical tables of F values for appropriate degrees of freedom.

comparison of the C group with the corresponding Placebo subgroup stands in sharp contrast. In the "Initial" Review the latter received the higher score for five of the six individual characteristics; and in the "Final" Review each received the higher score for three. The Vitamin subgroup corresponding to these two received the highest score for all six individual characteristics.

Both the "Initial" and "Final" scores of the C group and of the corresponding Placebo subgroup are nearly identical, from which it must be concluded that the psychotherapeutic elements in the Placebo group (and absent in the C group) did not make for a higher Merit Review score. By a similar argument the higher scores in the Vitamin group are to be ascribed to a therapeutic effect of the vitamin supplement.

The data in the section on absenteeism indicated the presence of

Table 15. Differences between mean Merit Review scores for Vitamin and Placebo groups and subgroups and between the nonparticipating control group and each of the corresponding Study groups.

GROUPS COMPARED	"INITIAL" REVIEW		"FINAL" REVIEW	
	Difference in Means	p ¹	Difference in Means	p ¹
"Whole" Class, All Shifts Placebo—Vitamin	+0.007	*	-0.159	<.001
"Whole" Class, Swing Shift Placebo—Vitamin	-0.008	*	-0.179	<.001
"Whole" Class, Day or Graveyard Shift Placebo—Vitamin	+0.105	>.05	-0.171	<.001
"Throughout" Class, Swing Shift Placebo—Vitamin	-0.021	*	-0.212	<.001
Control—Placebo	-0.034	*	-0.003	*
Control—Vitamin	-0.055	>.05	-0.215	<.001
"Throughout" Class, Day or Graveyard Shift Placebo—Vitamin	+0.226	.01-.05	-0.208	.01-.05

¹ P is the probability of obtaining group means as divergent or more so by chance.

* Means do not differ significantly; greater mean square is that "within characteristics." See Appendix Table 1 and Footnote 18.

an element of "strain" in the men who transferred to the day and graveyard shifts; this "strain" was not present, or was less, in those who remained on the swing shift throughout the Study year. The absenteeism data indicated also that this "strain" appeared to have been largely relieved by the vitamin supplement. Similar evidence both of the existence of the "strain" and of its relief by the vitamin supplement is seen in Table 16 which compares the changes in the Merit Review scores between the "Initial" and "Final" ratings for the different groups. The increase in the "Final" over the "Initial" Review scores was much smaller in the Placebo subgroups on the day and graveyard shifts than in those who remained on the swing shift. The Vitamin subgroups on the day and graveyard shifts also had smaller increases in their "Final" Reviews than the Vitamin swing shift subgroups; but the Vitamin subgroups were much more alike in their increases than the Placebo subgroups.

Table 16. Increase in "Final" over "Initial" mean Merit Review scores on all characteristics for Placebo and Vitamin subgroups and for the nonparticipating control group.

Class and Shift	Increase in Mean Score		
	C	Placebo	Vitamin
"Whole" Class Swing Shift		0.662	0.833
Day and Grave- yard Shifts		0.123	0.489
"Throughouts" Class Swing Shift	0.674	0.643	0.834
Day and Grave- yard Shifts		0.140	0.574

The scores in the Merit Reviews for the six individual characteristics all refer to different aspects of industrial morale. The reasons for this view have been given above. The higher Merit Review scores of the Vitamin group indicate, therefore, that the morale in this group became better, or improved more, than in the two control groups. Three independent lines of evidence, the data on absenteeism, industrial turnover, and Merit Review scores point, therefore, to the same conclusion; namely, that the effect of the vitamin supplement was to improve the morale or attitude toward the job of

the recipients, and that this effect was separate from the psychotherapeutic effect of the placebo.

AN ESTIMATE OF THE CUMULATIVE EFFECTS ON PRODUCTION OF THE
LESS ABSENTEEISM AND TURNOVER AND IMPROVED WORK
PERFORMANCE IN THE VITAMIN GROUP

The absenteeism rate of the Placebo group ("Whole" Class, All Shifts) in the second six months was 4.791 days per 100 working days, and in the corresponding Vitamin group, 3.899. The difference is 0.892 days per 100 working man days, or for a year of 254 working days the difference is 2.27 days per person.

The reduction in absenteeism in the Vitamin group expressed as a percentage of the rate of the Placebo group is $\frac{0.892 \times 100}{4.791} = 18.6$ per cent.

It is more difficult to estimate the gain from reduction in turnover than that from reduction in absenteeism. Expressed as a percentage of the rate in the Placebo group, the reduction in turnover in the Vitamin group was 26.9 per cent. The difference in cumulative rates of nonmilitary terminations for the year was 6.51 fewer terminations per 100 men in the Vitamin group. It has been estimated in the southern California aircraft industry that the loss to a company in the termination of an employe is about \$200. This reduction in turnover meant a gain of \$1,302 per year per 100 men employed, or \$13.02 per year per man employed. This saving is equal approximately to 1.63 days' wages per man per year.

The following discussion aims to estimate the gain to production from the reduction in absenteeism, the reduction in turnover, and from better general work performance in the Vitamin group as compared with the Placebo group.³⁹

The index of general work performance agreed on by both

³⁹ The figures given in the discussion which follows are not intended to be construed in a strict accounting sense. They are offered as admittedly rough indices to illustrate the principle and to indicate the relative orders of magnitude of the gains from reduction in absenteeism, reduction in turnover, and improvement in general work performance. The principle applies regardless of the means employed to obtain these benefits.

SOURCE OF GAIN IN PRODUCTION	PER CENT IMPROVEMENT IN VITAMIN GROUP	MAN DAYS GAINED PER MAN PER YEAR	PER CENT OF TOTAL DAYS DERIVED FROM EACH SOURCE
Reduced Absenteeism	18.6	2.17	21.6
Reduced Turnover	26.9	1.63	15.5
Better General Work Performance (Merit Review Scores)	2.6	6.60	62.9
TOTAL		10.50	100.0

Table 17. Estimated gain in production, expressed as days per man per year, from the reduction in absenteeism and in turnover, and from improved work performance for employees receiving the vitamin supplement.

management and the Union is the Merit Review score. This index, no doubt, leaves much to be desired, but it was the only one available and it is widely used. The Placebo and the Vitamin groups received practically the same Merit Review scores at the beginning of the Study. At the end of the Study the mean "Final" total score of the Vitamin group was 6.377 and of the Placebo group, 6.218; and the ratio of the former to the latter expressed as a per cent is 102.6.

A 2.6 per cent higher Merit Review score may be taken to represent the greater worth to the production of the Company, and for the sake of this discussion is expressed at 2.6 per cent more work per man. Small as the figure 2.6 per cent is, translated into working days it amounts to a gain of 6.60 working days³⁰ per man per year ($.026 \times 254$), which is nearly three times the gain from the 19 per cent reduction in absenteeism and four times the gain from the 27 per cent reduction in turnover.

The gain in terms of man days of work from the reduction in absenteeism, improved general work performance, and reduced turnover is presented in Table 17. The gain from these three respects, in which the Vitamin group was superior, is represented by

³⁰ This is probably a very conservative estimate.

the estimated figure of 10.5 man days per man year. This corresponds to a gain in manpower of 4.1 per cent $\left(\frac{10.5 \times 100}{254}\right)$. The

total gain from the favorable effects seen in the Vitamin group probably exceeds that in these three specific expressions of work performance which could be measured.

The figures in Table 17 estimate only the gain from the therapeutic effect of the vitamin supplement. There was in addition, as discussed in the section on absenteeism, a psychotherapeutic effect exerted by both the placebo and the vitamin supplement which tended to reduce Illness absences.

SUMMARY

A supplement containing six vitamins and calcium was given to a group of aircraft workers for a year, and a placebo was given to a second group. Men in these groups were volunteers, and evidence is presented that they were superior to the average of industrial workers. A second control group was formed from employees who did not participate actively in the Study.

Initially, these groups were alike in age, duration of employment, and Merit Review scores. The quality of diets, as reported by members of the Placebo and Vitamin groups, was the same and remained essentially unchanged.

In the first six months of the Study year the Placebo and Vitamin groups had similar absenteeism rates from all causes, and from specific causes classified as Unauthorized, Illness, and Authorized absences.

In the second six months the total absenteeism rate of the Placebo group was 4.79 days per 100 working days, and of the Vitamin group, 3.90 days. This difference of 0.89 days is statistically significant and represents a reduction in absenteeism of 18.6 per cent.

There was a reduction in absenteeism in the Vitamin group in each of the above three categories; the reduction was greatest in Unauthorized absences and least in Illness absences.

The subjects were classified according to changes in work shift and period under observation (twelve months and nine months but less than twelve). In every comparison of matched subgroups the Vitamin subgroup had a significantly lower absenteeism rate. As in the case of the total Placebo and Vitamin groups, the greatest differences were in Unauthorized absences.

Comparison of absenteeism in the Placebo and Vitamin groups with that of a matched nonparticipating control group showed that the giving of both the placebo and vitamin supplement exerted a psychotherapeutic effect. This effect was persistent in reducing Illness absences throughout the Study year. It reduced Unauthorized absences at first, but this effect did not persist through the second six months.

The rate of nonmilitary terminations was nearly equal in the Placebo and Vitamin groups in the first four months. For the remaining eight months this rate was 38 per cent lower in the Vitamin group. This difference is of borderline significance statistically.

Merit Review scores for the total Placebo and Vitamin groups, which were initially similar, showed a significant superiority of the Vitamin group at the end of the year. The same superiority appeared in the matched subgroups.

The Merit ratings of the Placebo and the nonparticipating control groups showed no significant differences in their "Initial" or "Final" Reviews, indicating that the psychotherapeutic effect did not make for higher Merit Review scores.

A conservative estimate of the over-all gain to production from the therapeutic effect of the vitamin supplement on absenteeism, turnover, and general work performance is 10.5 working days per man per year, corresponding to a gain in manpower of 4.1 per cent. Of these, 6.6 days are the result of improved work performance, 2.3 days are from a reduction in absenteeism, and 1.6 days are from reduced turnover. These figures exclude gains due to psychotherapeutic effects.

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The three independent lines of evidence furnished by the data on absenteeism, turnover, and Merit Review scores point toward improvement in industrial morale as the major factor responsible for the statistically significant effect of the vitamin supplement.

The consistency of the trend toward superior performance in the Vitamin group as the Study year progressed is the most persuasive feature of the evidence for crediting benefit to the therapeutic effect of the vitamin supplement. This consistency runs through all the causes given for absence, the data on turnover, and all six individual items in the Merit Review scores; it is seen in the comparison of the total populations of the Placebo and Vitamin groups and in the comparisons of their four subgroups.

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Appendix Table 1. Results of analysis of variance for comparisons of Merit Review scores for Placebo and Vitamin groups and subgroups and for Placebo and Vitamin groups with a nonparticipating control group.

GROUPS COMPARED AND SOURCES OF VARIATION	"INITIAL" MERIT SCORES				"FINAL" MERIT SCORES			
	Degrees of Freedom	Mean Square	F ¹	P ²	Degrees of Freedom	Mean Square	F ¹	P ²
<i>"Whole" Class, All Shifts</i>								
Within Characteristics	2,508	1.207			2,508	1.178		
Between P and V Means	1	0.036	*	*	1	17.527	14.9	<.001
Among Means of Charac.	5	18.399			5	8.946		
Interaction	5	0.115			5	0.810		
<i>"Whole" Class, Swing Shift</i>								
Within Characteristics	1,932	1.244			1,932	1.235		
Between P and V Means	1	0.033	*	*	1	15.433	12.5	<.001
Among Means of Charac.	5	14.171			5	6.676		
Interaction	5	0.091			5	0.560		
<i>"Whole" Class, Day-Graveyard</i>								
Within Characteristics	564	1.094			564	0.917		
Between P and V Means	1	1.531	1.4	>.05	1	10.175	11.1	<.001
Among Means of Charac.	5	4.427			5	2.582		
Interaction	5	0.147			5	0.291		
<i>"Throughout" Class, Swing</i>								
Within Characteristics	1,692	1.199			1,692	1.254		
Between P and V Means	1	0.181	*	*	1	18.990	15.1	<.001
Among Means of Charac.	5	12.932			5	5.615		
Interaction	5	0.228			5	0.402		
<i>"Throughout" Class, Day-Graveyard</i>								
Within Characteristics	456	1.208			456	1.059		
Between P and V Means	1	5.767	4.8	.01-.05	1	4.859	4.59	.01-.05
Among Means of Charac.	5	3.317			5	2.115		
Interaction	5	0.054			5	0.235		
<i>C and P Groups</i>								
<i>"Throughout" Class, Swing</i>								
Within Characteristics	1,914	1.154			1,914	1.147		
Between C and P Means	1	0.577	*	*	1	0.004	*	*
Among Means of Charac.	5	14.247			5	4.711		
Interaction	5	0.207			5	0.386		
<i>C and V Groups</i>								
<i>"Throughout" Class, Swing</i>								
Within Characteristics	1,746	1.190			1,746	1.115		
Between C and V Means	1	1.325	1.1	>.05	1	20.033	18.0	<.001
Among Means of Charac.	5	12.679			5	4.059		
Interaction	5	0.150			5	0.264		

¹ F is ratio of mean square for group means to the mean square "within characteristics" (see Footnote 18).

² P is the probability of obtaining group means as divergent or more so by chance.

* Greater mean square is that "within characteristics"; means do not differ significantly.

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THE WAR-TIME NUTRITION PROGRAMS FOR WORKERS IN THE UNITED STATES AND CANADA

ROBERT S. GOODHART, M.D.¹ AND L. B. PETT, PH.D., M.D.²

INTRODUCTION

THE "raison d'être" of a nutrition program for industrial workers is the need of such workers for adequate food to maintain health, efficiency, and morale. The nature and uncertainty of their employment, their usual educational, economic, and social status, their hours of work and general urbanization, make industrial workers as a group (and their families) extraordinarily vulnerable to food shortages, high food and other living costs, and poor dietary practices. Their welfare should be a particular responsibility of their government at all times. However, in modern times, it has become obligatory for a nation at war to take special measures to protect the nutritional status of its workers.

Nutrition programs for workers should have three components: education, food supply, and price control. They should be operated in conjunction and in harmony with similar programs conducted for the general civilian population and they should be set up to reach and affect the worker both at his place of employment and at his home.

As part of a nutrition program, the provision of food services for the worker, at his place of employment, has certain tangible advantages to a nation at war:

1. It is a medium for obtaining the best possible use of available foods and it is a mechanism for providing workers with the food they need in addition to their individual ration allowances.
2. It is a means of applying nutrition principles and scientific techniques in the feeding of a large and important segment of the popula-

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tion, thus improving the health of the nation. No other method has proved as effective as group feeding, with its possibilities for the application of educational procedures and principles of mass psychology, in influencing the food habits and food consumption of normal individuals other than infants and small children.

3. It serves to protect and improve the workers' health and morale thus improving employe-management relationships and increasing the production of war materials.

The development of nutrition programs for workers in the United States and Canada reflects the importance attached to the nutritional welfare of the industrial worker in wartime by the Governments of these two countries.

THE NUTRITION PROGRAM FOR WORKERS IN THE UNITED STATES

The nutrition program for workers in the United States is the expression by the Government of recommendations made by the National Nutrition Conference for Defense, held in Washington, D. C., May 26-28, 1941, and by the Committee on the Nutrition of Industrial Workers of the Food and Nutrition Board, National Research Council, in April 1942. Pertinent excerpts from these recommendations are:

It is urgently recommended that special attention be paid to the diets and nutrition of all workers in industry and particularly of those most directly concerned with the national defense effort.

Nutritious meals of natural foods at prices the workers are accustomed to and can afford to pay should be made available in all plants engaged in production for war or defense purposes, except in small plants where the worker may obtain such meals from private sources in the free time at his disposal.

Suitable educational material should be presented in connection with cafeteria service or supplementary lunches to stimulate acceptance of the meals planned or the selection of good meals when there is a choice of foods.

A section to develop a nutrition program for industry was established within the Nutrition Division of the Office of Defense Health

and Welfare Services, Federal Security Agency, August 1942, when it became apparent that nutrition education programs addressed to the general population and operated through community nutrition committees, composed largely of volunteer workers, could not be depended upon to reach and influence substantial numbers of industrial workers as quickly as is necessary in wartime.

The Nutrition Division is now the Nutrition Programs Branch of the Office of Marketing Services, War Food Administration, and the Nutrition in Industry Section has become the Industrial Feeding Programs Division of the School Lunch and Distribution Branch, Commodity Credit Corporation, War Food Administration. The transfer from the Office of Defense Health and Welfare Services to the War Food Administration occurred March 6, 1943, by executive order of the President. The move was considered desirable by the persons responsible for both nutrition programs because it was believed that their programs would be more effective and better received if they were recognized components of the war food program.

The organization of the industrial nutrition program involves various Federal agencies whose primary interest in the program is based on its value in increasing productive efficiency of workers and thus speeding production of war supplies. The Director of the Office of Supply, Commodity Credit Corporation, is Chairman of the Inter-Agency Committee on Food for Workers, on which ten agencies are represented. In addition to the War Food Administration, these include the War Production Board, the War Manpower Commission, the War Department, the Navy Department, the Maritime Commission, the United States Public Health Service, the Federal Works Agency, the Office of Price Administration, and the Federal Public Housing Authority. In addition to the Federal program, various State health and labor departments and local agencies have active cooperating programs in different sections of the country.

The War Food Administration is responsible for program development and coordination. It provides technical advisory services to labor and management, to other Federal agencies and to State and local agencies and groups. It also serves as a "clearing house" for the handling of requests for assistance. It screens applications for facilities and brings trouble spots to the attention of the appropriate agency. It has the prime responsibility for nutrition education programs and sole responsibility for the solution of food supply problems involving nonrationed items. The procurement agencies (Army, Navy, and Maritime Commission), the War Production Board, and the President's Committee for Congested Areas have varying responsibility for seeing that recommendations actually reach the stage of implementation. The War Food Administration has no legal authority to demand compliance with recommendations made in the conduct of its industrial nutrition program.

Industrial feeding specialists, working out of the five regional offices of the Commodity Credit Corporation, visited and rendered technical assistance to more than 1,120 plants employing more than five million workers up to October 1, 1944. In most instances requests for assistance have come directly from management although Federal agencies and management jointly have requested service in many cases. The industrial feeding specialist is not authorized to visit plants without a request from management, or the responsible procurement agency, that he do so.

In addition to providing help with specific operating and facilities problems, aid is given in the organization and conduct of nutrition education programs. Approximately 50 per cent of the plants serviced by the industrial feeding specialists have been given assistance with, or advice on, nutrition education programs. To be effective such programs must be conducted continuously as an integral part of the food service operation, thus necessitating periodic personal and mail contact. The industrial feeding program monthly publications, *Industrial Nutrition Service* and *Serving*

Many, are two of the media used for maintaining such contacts. These publications, sent only upon request, are devoted largely to encouraging the best use of available foods and reach about 2,000 plants employing about eight million workers. The material in them is reprinted in plant and union publications and is used in other ways for education programs. The mailing lists are being expanded steadily as technical service is provided to additional establishments. Posters, table tents, and leaflets are available, free of charge, to interested plants and labor groups. An excellent manual on "Industrial Feeding Facilities" has had a wide distribution among equipment manufacturers and distributors, engineers, architects, training schools, colleges, hospitals, and business and professional associations. More than 125,000 copies of a manual of industrial nutrition and more than 80,000 copies of a meal-planning guide for industrial food services have been distributed in response to requests. A booklet entitled "Making the Most of Meats in Industrial Feeding," was published in January 1945, and further manuals are now in preparation.

To answer the question whether in-plant nutrition education programs can be effective in changing eating habits of industrial workers, the War Food Administration conducted a study (1943) in several plants in two communities. Briefly, the survey showed that a well-run in-plant nutrition education program can be effective in changing eating habits, when integrated with the plant food services. Sixty per cent of the workers eating in the cafeteria of one plant indicated changes in their dietary practices since onset of the nutrition program. Twenty-five per cent of this group disclosed an extension of the effects of the nutrition program into the home.

Figure 1 presents one company's own appraisal of the effects of a nutrition program it developed for its employees.

Because of the small number of industrial feeding specialists (18) available for field work, it has been impossible for most of them to do much more than respond to requests for assistance on specific

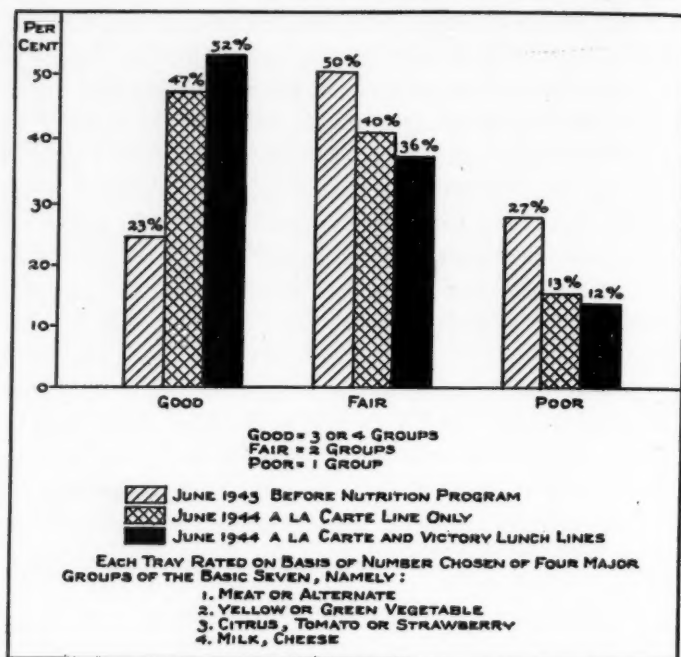


Fig. 1. Changes in food choices of employees under eight months of Tapco's Nutrition Program.

problems arising in the installation or operation of food services. Continued and recurring assistance and guidance in the development of educational programs of necessity have failed to receive as much attention as they merit. To some extent this deficiency has been offset by the educational materials prepared in Washington for distribution to management, labor, dietitians, physicians, and food service operators throughout the country.

Through its Nutrition Programs Branch, the War Food Administration directs and coordinates community nutrition education activities. This is effected through providing advice and assistance to State Nutrition Committees which exist in every State. The State

Nutrition Committees, in turn, stimulate the formation and activities of local committees in their States. The local nutrition committees are responsible for community nutrition activities for industrial workers and their families, as well as for other groups. The activities of the Nutrition Programs Branch and the Industrial Feeding Programs Division are correlated as much as possible in Washington and in the field.

One of the objectives of the industrial nutrition program is reasonable prices for meals served in industrial feeding establishments. To aid in achieving this, the War Food Administration provides plant management and food operators with advice on efficient and economic facility installations, methods of operation, foods, and meal planning and preparation. Authority for the actual control of prices in all public eating places rests with the Office of Price Administration.

The Office of Price Administration regulation governing prices in eating and drinking establishments (Rest. MPR 2, June 29, 1944; amended July 31, 1944) set up the "general rule" that the ceiling price for any meal, food item, or beverage, except coffee, is the highest price at which the same meal, food item, or beverage was offered, by the operator concerned, during the week of April 4-10, 1943. The regulation further makes provision for establishments that were not in business during April 4-10, 1943, and for the determination of ceiling prices on items that were not sold by a particular establishment on that date. Special rules governing the prices of coffee are also given. No distinction is made between industrial food services and other restaurants and hotels.

Industrial feeding is recognized by industry as important for employe health and morale and for production. Acceptance is evident from the participation in the program shown by the War Food Administration Survey of Industrial Feeding in Manufacturing Establishments (July 1944). The survey indicated that about five and one-half million industrial workers in manufacturing

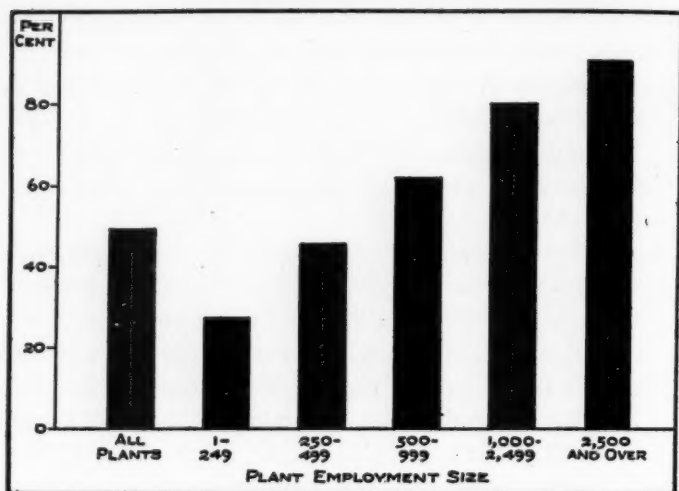


Fig. 2. Percentages of plants with various numbers of employees which had food service facilities. Data from War Food Administration Survey, March 1944.

establishments were obtaining food on the job, and that facilities were being planned to feed an additional one and a half million workers. By the end of 1944, at least seven million workers in manufacturing industries obtained some food on the job. These seven million workers are being fed in about eleven thousand manufacturing plants and represent approximately 43 per cent of the workers now employed in manufacturing.

Half of all manufacturing plants now have some type of on-the-job feeding (Fig. 2 and Fig. 3). In the larger plants, on-the-job feeding is more widely practiced. War Food Administration records on facilities in use during March 1944, plus those being planned at that time, indicate that 95 per cent of the manufacturing plants employing 1,000 or more workers have some type of food service. These large plants employ about three-fourths of the workers engaged in manufacturing.

In addition to manufacturing, there are twenty-three million

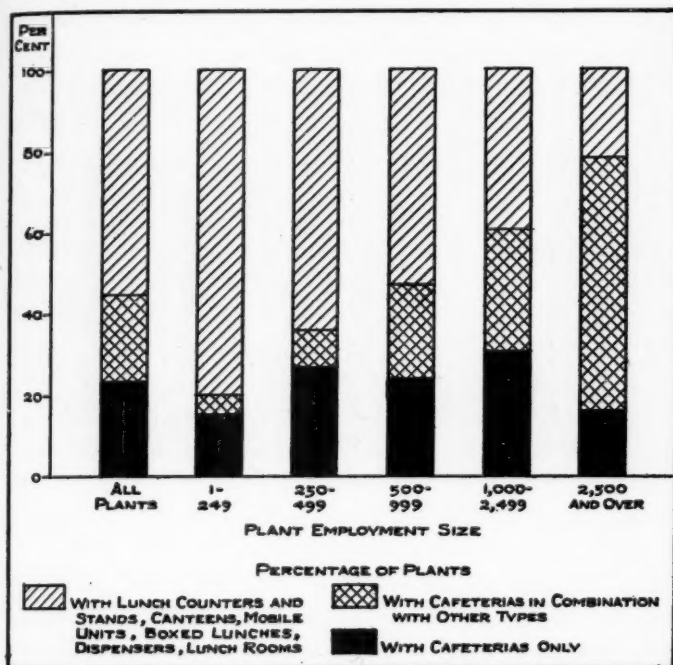


Fig. 3. Percentages of plants with various types of food service facilities according to number of employees. Data from War Food Administration Survey, March 1944.

workers employed in nonmanufacturing such as trade, finance, government, construction, etc. While accurate data are not available on the extent to which on-the-job feeding may be practiced in connection with these groups, assistance has been given to many companies in these fields and a significant number of workers in such industries are employed in units where on-the-job feeding is practiced.

An independent survey of large manufacturing firms made during 1944 by a member of the paper cup industry reached the conclusion that industrial feeding has become a permanent and accepted part of labor-management relations. Only one of 101 plants signi-

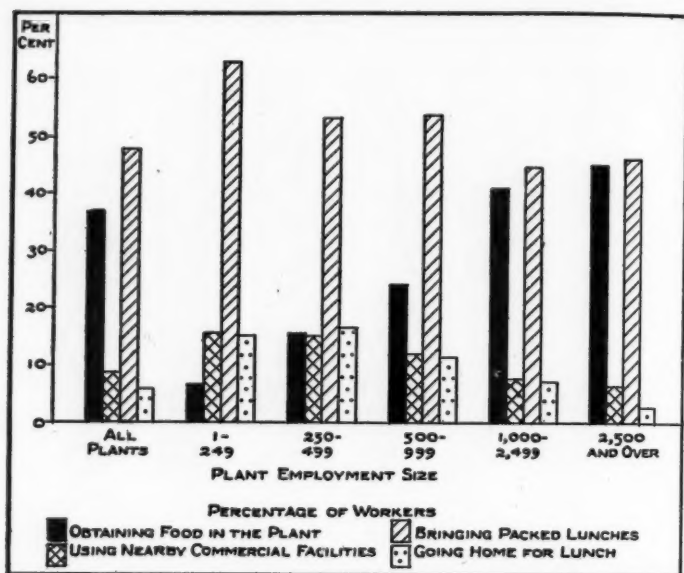


Fig. 4. Sources of mid-shift meals for workers on all shifts in plants classified according to number of employees. Data from War Food Administration Survey, March 1944.

fied the intention of discarding its industrial feeding program after the war. Answers from the remaining plants indicated approval of and satisfaction with on-the-job feeding and the intention to improve their food services after the war.

Many plants operate their food services on a nonprofit or a loss basis as an essential service needed by their workers. The resultant improvement in labor relations and employee efficiency is considered a good return on the funds expended.

The acceptance of the program by workers is indicated by the increase in utilization of plant feeding services, due, in a measure, to their growing realization that it is important for their health and welfare to eat adequate meals. While the home-packed lunch still represents the largest single source of mid-shift meals, thousands of

workers are discarding the lunch pail to take advantage of their plant food service. Less than 7 per cent of the workers go home for lunch and less than 9 per cent use nearby commercial facilities (Fig. 4).

INDUSTRIAL NUTRITION PROGRAM IN CANADA

' Method of Operation. The Industrial Section of the Division of Nutrition, Department of National Health and Welfare, Ottawa, inspects Canadian war plants for the purpose of studying their food facilities, to see that workers have a good chance of being well-fed, and recommending improvements. The work is carried out under the authority of Order-in-Council P.C. 1550 establishing regulations for the conservation of the health of workers in war industry.

This Order-in-Council provides that any authorized officer of the Department may inspect war contract premises and examine any equipment and persons therein, and may require the owner or occupier to permit the display of posters and the distribution of health and safety literature approved by the Minister, to maintain satisfactory sanitary conditions and lighting, heating, ventilation and toilet facilities, medical and nursing services and to "satisfy the nutritional and other standards specified by the Minister with respect to any foods which are or may be provided—for the employees either by the owner—or by any other person." Penalties of fine or imprisonment are provided for contravention of the Order.

The purpose of these inspections is to help Canada's war workers to be well fed. With this all-embracing object in mind more than just the presence of a cafeteria is considered; a comprehensive industrial nutrition program is being developed. It is believed that as the industrial nutrition program expands it will form a valuable center of interest in each community.

For all work of the Division of Nutrition Canada is divided into five regions, and a nutritionist is assigned to each region. Her duties are to inspect industries within the region, to promote an exchange

of information of all kinds, and to work with Provincial Health Departments in local developments.

By "inspection" is meant that a trained nutritionist from Ottawa visits the plant, and obtains answers to all questions on a form or questionnaire. The management is contacted by letter before a visit, and personally during the visit. The medical services are visited only briefly since they are subject to other control. Medical services are often very much interested in the feeding of the employees, so that this contact is found valuable.

Table 1. In-plant food facilities in Canada based on inspection of 584 Canadian War Industries,¹ to December 31, 1944.

TYPE OF SERVICE AVAILABLE	NUMBER OF PLANT EMPLOYEES				
	Less Than 100	100-499	500-999	1,000 or More	All Plants
Number of Plants Visited	29	304	119	132	584 ²
Per Cent (Approx.) of All War Plants of Similar Size	2	46	75	87	29
Number of Plants With Specified Service ³ :					
Hot Canteens	1	57	44	71	173
Cold Canteens	5	84	49	44	182
Mobile Canteens	6	48	31	35	120
Mess Rooms	8	93	52	46	199
Milk Deliveries	13	90	16	11	130
No Facilities	3	28	15	4	50
Dietitian	—	5	5	15	25
Food Manager	2	61	42	65	170
Plant Operated Canteen	3	48	37	39	127
Concession Operated Canteen	1	66	41	55	163
Employee Operated Canteen	1	21	7	5	34

¹ The 584 plants inspected up to December 31, 1944 comprise over one-quarter of the total number with war contracts, and nearly half the war workers in Canada. No estimate can be given relating these figures to the total industries in Canada, especially those of small size.

² Of these 584 plants, which are representative of the whole war industry, approximately 30 per cent have provision for a hot meal, 29 per cent have a cold canteen permitting some kind of meal, and 8 per cent have no facilities of any kind, not even a milk delivery. The other 33 per cent have a mobile unit and/or mess room.

³ Definitions of food services: Hot Canteen indicates any service where a hot meal is available; Cold Canteen is a stationary food service where the only hot foods served are beverages and soups; Mobile Canteen is a food service that can be moved to various stations throughout the plant at stated times during the day; Mess Rooms are rooms provided for the use of employees who carry their lunches to work.

An actual inspection is made of all food services. Not only is the general lay-out and cleanliness considered but also the preparation and serving of meals. The menus receive close scrutiny. In order to check the probable quantities received by each person, care is taken to find out the number of meals served, and also the quantity of milk and other refreshments purchased.

The report also lists the number of neighborhood and nearby restaurants, how many workers carry lunch boxes, and the reasons why the cafeteria is or is not well patronized. This gives information which may be used to help other plants faced with similar problems.

Following the inspection, the questionnaire is studied by the nutritionist visiting the plant and sometimes by a group of nutritionists, and a letter containing recommendations is sent to the company. These recommendations may include suggested plans for new extensions, menus, recipes, and many other kinds of help. Copies are sent to other interested people in the plant, and a reinspection is arranged at a later date.

An additional service from the Ottawa office is an informal arrangement whereby the offices controlling (a) construction materials, (b) priority equipment, or (c) rationed foods, refer requests from plants to the Division of Nutrition for a statement on essentiality. This arrangement has worked well without a formal committee.

Studies are carried out on the effectiveness of different publicity procedures in plants, but this work must be continued for some time

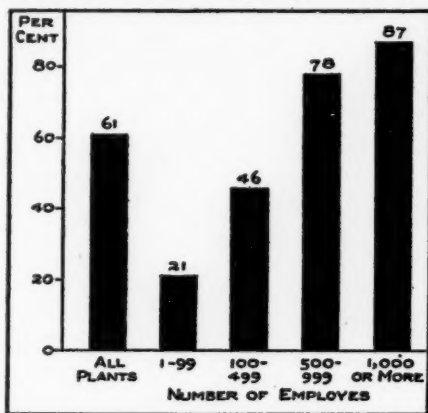


Fig. 5. Percentages of Canadian plants surveyed having hot or cold canteens.

CHANGES IN FOOD FACILITIES	NUMBER OF PLANT EMPLOYEES				
	Less Than 100	100-499	500-999	1,000 or More	Total
Number of Plants Revisited	5	87	61	77	230
Improved Hot Canteens	—	19	16	41	76
New Hot Canteens	—	10	4	8	22
Improved Cold Canteens	—	20	5	17	42
New Cold Canteens	—	12	3	12	27
New Mobile Canteens	—	7	4	5	16
New Mess Rooms	—	9	7	9	25
New Milk Deliveries	1	5	1	2	9

Table 2. Improvement in food service facilities found by reinspection of 230 war plants in Canada.

before generalizations are possible. So far, it has not been possible in Canada to express in exact figures the effects of in-plant feeding on health or other factors. Numerous cases of improved morale, of averted strikes, and of lessened frequency of accidents have been reported and are investigated.

Degree of Acceptance.

The degree of acceptance of the Industrial Nutrition Program in Canada is indicated not only by the welcome accorded inspectors, but more measurably:

(a) By the number of plants with in-plant feeding (Table 1 and Fig. 5) and particularly by those showing improvement

in their food services on a follow-up visit by a government nutritionist (Table 2 and Fig. 6). Of 230 plants reinspected, about two-thirds showed definite improvements. Since many were very good at the first

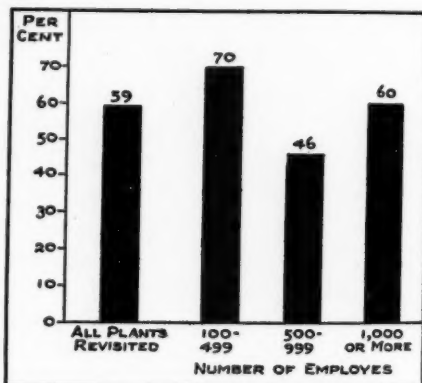


Fig. 6. Percentages of Canadian plants revisited having new or improved hot or cold canteens.

inspection, it could not be expected that actual improvement would be noted in all cases. In no case was there a regression from the previous standard.

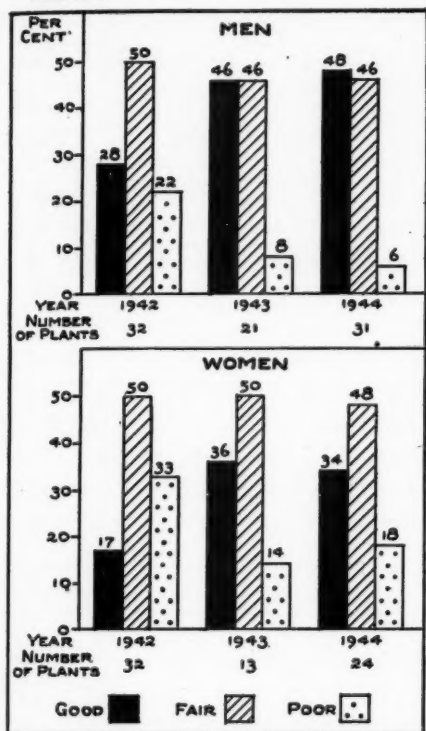


Fig. 7. Average percentages of lunches, bought or carried, classified as good, fair or poor for men and women in representative Canadian war plants. Lunches which included a protein food, a fruit or vegetable, and milk were scored good; those with any two of these food groups were fair; and those with only one or more were poor.

(b) By the scoring of lunches (Fig. 7), of which 72 per cent of those selected by men were fair or poor in 1942, while only 54 and 52 per cent were fair or poor in 1943 and in 1944, respectively. Lunches selected by women showed similar improvement.

(c) By requests for help. Table 3 indicates those requiring special service not covered by manuals or bulletins ready for distribution.

(d) By letters of appreciation, of which many have been received. In these letters appear such phrases as "happy indeed to cooperate," "appreciate your constructive criticism," "have adopted your suggestions," "your various bulletins will be of great benefit," "will take steps forthwith," "very beneficial."

(e) By the distribution of printed matter to industry (Table 4). This has been sent on request only and therefore the amount is indicative of acceptance. Nearly 1,000 industries, almost double the number which have been inspected, have been receiving printed matter.

DISCUSSION

Although the objectives of both are the same, there are certain fundamental differences between the organization of the nutrition program for workers in Canada and its organization in the United States.

In Canada, the program is a function of the Ministry of National Health and Welfare, a permanent Federal agency. It has the authority of an "Order-in-Council" which requires

plants with war contracts to permit inspections of their premises and provides for punitive measures if recommendations of the Ministry are not carried out. Although this Order is a War Emergency Measure, the service will be continued after the war for those who wish it.

Table 3. Requests for help not answerable by ready-prepared manuals, to December 31, 1944.

SUBJECT OF REQUESTS	NUMBER
Foods Rationed or in Limited Supply	20
Menus, Types of Meals	28
Improvement of Lunch Scores	17
New Buildings, New Equipment (Other Than From Controllers)	20
Plant Campaign, Exhibits, Classes	32
Speakers, Motion Pictures	12
Plant Papers	22
Vitamin Concentrates	3

Table 4. Distribution of printed matter to Canadian war plants, on request only, to December 31, 1944.

	NUMBER OF PLANTS	QUANTITY DISTRIBUTED
War Industry Kit ¹	40	71
Flier Series 1, #1, 2, 3, 4, 5	586	1,917,000
Series 2, #1, 2, 3, 4, 5	372	1,711,000
Nutrition in Wartime	19	2,778
Nutrition in Industry	156	329
Industrial Nutrition Program	114	189
Healthful Eating	44	432
Foods for Health Poster	150	738
Wartime Victory Lunches	322	89,081
Score Sheets	34	11,927
Caterers' Bulletins	450	4,776

¹ War industry kit contains a sample of all available industrial nutrition publications.

In contrast, nutrition activities for workers in the United States are primarily the responsibility of the War Food Administration, a war agency whose continued existence is dependent upon the demonstrable need for such an agency in the further conduct of the war and in making immediate post-war agricultural readjustments. Individual plant surveys are made only in response to requests from plant management or one of the procurement agencies (Army, Navy, and Maritime Commission). The War Food Administration is not in a position to insist that industry accept its recommendations on nutrition programs for the workers. Plant survey reports are supplied to the procurement agencies, the War Production Board, the War Manpower Commission, and the President's Committee for Congested Areas, upon their request, so that they can take whatever steps they believe to be necessary. Sanitary regulations are policed by the procurement agencies, the United States Public Health Service, and the State and local health departments.

Undoubtedly, the voluntary nature of the program in the United States has been responsible for nonacceptance in some instances. However, for the most part industry has shown itself anxious to do a good job of feeding its workers and has requested services from the Government in excess of the capacity of the War Food Administration.

There are, of course, millions more workers and thousands more plants in the United States than in Canada and some of the differences in organization are accountable to this; e.g., regionalization of activities and greater dependence upon State and local groups in the United States. A more striking difference in method of operation appears to be the greater emphasis placed upon facilities and equipment problems in the United States.

The War Food Administration certifies as to the appropriateness of floor plans and the adequacy of facilities for industrial food services, before priorities are granted by the War Production Board to permit installation. In Canada this is done informally on request

of the particular Controller. As an extension of this work, the War Food Administration has prepared basic plans and equipment lists for all types of industrial food services and is distributing them widely to industry, architects and engineers, equipment manufacturers, and dealers and schools. This is designed to aid in placing industrial feeding on an economically sound and efficient basis.

Unfortunately, neither in the United States nor in Canada have there been any scientifically conducted studies during the past few years to determine the benefits which accrue to the worker and to management from industrial nutrition programs. Those in charge of any peacetime Government nutrition program for workers must be in a position to stimulate and sponsor fundamental investigative work on the nutritional requirements and food habits of workers and the effect of good feeding practices upon industrial efficiency.

Both the Ministry of National Health and Welfare in Canada, and the War Food Administration in the United States, have received many letters from plant managements expressing their conviction that the food services provided for their employes were well worth the time and money spent on them. There is every reason to believe that industry will continue its interest in the nutrition of its employes during peacetime and that the practice of on-the-job feeding will be further extended and improved (*see* page 169).

Continued interest by the United States Government is to be expected. Aside from the fact that well-fed, healthy, efficient, and happy workers should be as much the concern of a nation at peace as of one at war, the industrial workers and their families represent a large food market. Industrial food services today comprise the largest concentrated food market in the United States. Seven million workers now patronize plant food services, twelve million can be reached with an expanded program. This represents a potential post-war market for about four million tons of agricultural products at a wholesale value of approximately one billion dollars.

The Canadian Government plans to make its nutrition services

available to all industries, and possibly extend them to summer camps, small institutions, and public eating places in the post-war period. It is not possible, at this time, to prognosticate on the future of the Federal industrial nutrition program in the United States as this depends upon its being incorporated in one of the permanent Federal agencies.

LENGTH OF LIFE OF PARENTS AND OFFSPRING IN A RURAL COMMUNITY²

SALLY PREAS

VARIOUS studies have been made on the relationship between the length of life of parents and offspring. A number of these studies (1) have indicated that longevity is an inherited character or at least that it is the result of an inherited constitution. Since, however, a considerable amount of the evidence has been derived from specially selected groups, there is room for further investigation of this subject. The family-history records collected in Cattaraugus County during the period 1931-1933 furnish valuable data for a study of the relationship between the length of life of parents and offspring.

DATA AND METHOD OF STUDY

In connection with a study of morbidity conducted in a rural area, Cattaraugus County, New York, by the United States Public Health Service in cooperation with the Milbank Memorial Fund, an effort was made to obtain a history of the parents and sibs of both the husband and wife in each of the 1,400 families in the morbidity survey. The data included in the history which have a bearing upon this report are: (1) the date of birth of each member of the family; and (2) the age at and the date of death, and the cause of death for all who were deceased at the time the survey was made. In addition, a history of residence and occupation of the father during the first fifteen years of married life was obtained for each family.

Every effort was made to obtain as complete and accurate family-history records as possible. In many instances the family Bible was used as a source of information or at least as a check of the accuracy of the data obtained from the informant. When there was uncer-

² From the Milbank Memorial Fund.

Acknowledgments are made to the United States Public Health Service who cooperated in collecting the data in connection with a morbidity study.

tainty as to the date of death or age at death for a deceased member of the family and the place of burial was known, the cemetery was visited and this information was taken from the gravestone. If the grave could not be located, the records of the sexton of the burying ground were consulted for the needed information. Occasionally a part of the family-history record was obtained through questionnaires sent to surviving members of the family or relatives living in various parts of the United States. In fact, all available channels were used in an effort to obtain a complete record for each family.

The families included in this study are those in which there were offspring born during the three decades 1850-1859, 1860-1869, and 1870-1879.² A family may have had offspring born in two of the selected decades or even in all three. Children who died under 1 year of age are excluded because of the inaccuracies and omissions in reporting deaths of infants. The study is limited to families in which both parents were dead at the date of enumeration. None of the living offspring could have been less than 50 years of age at the time of enumeration and many would have had an opportunity to live more than 70 years.

In the calculation of the mortality experience of the offspring, the modified life-table method of analysis is used; that is, each year of life of each person is considered as a unit and the total person-years derived in this manner constitute the total population of offspring.

The mortality experience of a population derived from family-history records obtained in the manner described above cannot be considered as truly comparable with mortality rates obtained by census enumerations and recording of current deaths. In practically all instances a survivor in the family was a requisite for obtaining

² When data concerning date of birth or age at death or cause of death were lacking for some members of the family, the entire record was discarded; also records for foreign-born families were excluded. In an earlier study which included families in which all the children were born previous to 1901, 16 per cent of the total family histories were considered unsuitable for use because of these reasons (2). It is probable that the per cent of records discarded in this study would not differ very widely from that of the previous study, since the larger group included some families in which children were born prior to 1850 as well as some in which the offspring were born after 1879.

RESIDENCE OF FAMILY DURING FIRST 15 YEARS OF MARRIED LIFE	OFFSPRING BORN 1850-1859	OFFSPRING BORN 1860-1869	OFFSPRING BORN 1870-1879
	PER CENT		
TOTAL	100.0	100.0	100.0
Rural ¹	87.0	88.0	86.8
Village ¹	6.5	7.0	7.6
City ¹	6.5	5.0	5.6
TOTAL	100.0	100.0	100.0
Cattaraugus Co.	71.9	69.6	66.3
New York State Outside Cattaraugus Co.	20.7	21.7	23.0
Other Nearby Areas	6.4	8.7	10.7
	NUMBER		
TOTAL	226	413	475
Rural ¹	175	329	376
Village ¹	13	26	33
City ¹	13	19	24
Unknown Residence	25	39	42
TOTAL	226	413	475
Cattaraugus Co.	148	263	291
New York State Outside Cattaraugus Co.	42	81	101
Other Nearby Areas	13	33	47
Unknown Residence	23	35	36

¹ City: places over 10,000 population; village: smaller towns whether incorporated or not; rural: country or farm localities.

Table 1. Residence of families in which offspring were born during three decades in the period 1850-1879.

the record.² Families living in the vicinity in the same time period but which had died out completely are necessarily not included. Furthermore, the probability of having a surviving offspring in the community is influenced by the original number of offspring in the

² In a few cases where the wife and all members of her family were dead, the wife's family history was secured from the husband and vice versa.

family. These factors no doubt tend to weight the sample population with survivors. Although the mortality rates based on the sample population cannot be considered as describing exactly the forces of mortality of the period, there seems to be no reason to believe that comparisons of the relative mortality among various groups within the total population would be invalidated by the weighting of the population with survivors.

DESCRIPTION OF FAMILIES

The families included in the sample population appear to be relatively similar with respect to their general social and economic background. Table 1 shows the residence during the first fifteen

Table 2. Occupation of fathers of offspring born during three decades in the period 1850-1879.

OCCUPATION OF FATHER DURING FIRST 15 YEARS OF MARRIED LIFE	OFFSPRING BORN 1850-1859	OFFSPRING BORN 1860-1869	OFFSPRING BORN 1870-1879
	PER CENT		
TOTAL	100.0	100.0	100.0
Farming	59.6	66.8	67.8
Professional	3.6	4.2	3.4
Small Business ¹	10.5	7.6	6.6
Trades ¹	12.7	9.6	8.9
Laborers ²	13.6	11.8	13.3
	NUMBER		
TOTAL	226	413	475
Farming	131	271	320
Professional	8	17	16
Small Business ¹	23	31	31
Trades ¹	28	39	42
Laborers ²	30	48	63
Unknown Occupation	6	7	3

¹Small business includes proprietors of country stores, manager of cheese business, etc. Trades include: shoemaker, blacksmith, upholsterer, tailor, cabinet maker, carpenter, butcher, barber, and stone mason.

²Laborers include other than farm laborer, such as laborer on railroad, or on the roads, etc.

years of married life of the families classified according to the decade in which the offspring were born during the period 1850-1879. More than 85 per cent of the families lived in a rural area. The largest proportion of the families lived in Cattaraugus County; the remainder were from New York State or other nearby areas. The residence was similar for each decade. The occupation of the fathers during the first fifteen years of married life appears in Table 2. In each decade the largest proportion of fathers belonged to the farming class. The sample population is composed then of a relatively homogeneous group of rural families engaged mainly in farming in a community in which there appeared to be no important changes in residence or occupation during the three decades from 1850 to 1879.

MORTALITY OF OFFSPRING COMPARED WITH SURVIVORSHIP OF PARENTS

In order to study the relationship between the age at death of parents and offspring the families are grouped according to (1) those in which both parents survived to 70 years of age or over; (2) those in which both parents died under 70 years of age; and (3) those in which one parent died under 70 and one survived to 70 or over. The number of person-years are shown by age groups in Table 3 for the offspring of each group of parents according to the decade in which the offspring were born. The population of offspring of parents who died under 70 years of age is relatively small for each decade. Since it was noted earlier that the population characteristics of offspring born in different decades did not differ in any important respects, the populations and deaths for two decades can be combined provided the risk of dying is similar for the offspring born in different decades.

A comparison of the mortality for the three groups of offspring born in different decades cannot be made without taking account of the fact that persons born in 1870, for example, have not had as

Table 3. Number of person-years of offspring born in three decades, classified according to age of survival of both parents.

AGE GROUPS	OFFSPRING BORN 1850-1859	OFFSPRING BORN 1860-1869	OFFSPRING BORN 1870-1879	
	Population (Person-Years)			
ALL AGES	OFFSPRING OF PARENTS BOTH OF WHOM SURVIVED TO 70 YEARS OF AGE OR OVER			
	14,315	20,631	22,330	
	1- 4	898	1,439	1,705
	5- 9	1,087	1,716	2,072
	10-19	2,143	3,361	4,064
	20-24	1,044	1,620	1,988
	25-29	1,015	1,588	1,949
	30-39	1,965	3,071	3,796
	40-49	1,907	2,975	3,601
	50-59	1,804	2,803	2,853
	60-69	1,572	1,943	302
	70 +	880	115	
	ALL AGES	OFFSPRING OF PARENTS BOTH OF WHOM DIED UNDER 70 YEARS OF AGE		
		4,244	8,136	9,702
1- 4		293	586	783
5- 9		339	709	920
10-19		659	1,355	1,796
20-24		316	654	884
25-29		302	634	863
30-39		578	1,230	1,684
40-49		539	1,167	1,525
50-59		514	1,052	1,155
60-69		460	708	92
70 +		244	41	
ALL AGES		OFFSPRING OF PARENTS, ONE OF WHOM DIED UNDER 70 AND THE OTHER SURVIVED TO 70 OR OVER		
		15,437	26,936	29,066
	1- 4	997	1,935	2,259
	5- 9	1,193	2,332	2,740
	10-19	2,318	4,494	5,333
	20-24	1,134	2,152	2,604
	25-29	1,106	2,078	2,544
	30-39	2,162	3,992	4,951
	40-49	2,045	3,809	4,737
	50-59	1,901	3,544	3,595
	60-69	1,633	2,461	303
	70 +	948	139	

long an exposure to mortality risks as those born in 1850. All persons, however, have had an opportunity to survive to age 50, so that the mortality rates for ages 1-49 in Table 4 are comparable. The differences between the rates for each decade are not relatively large and are not consistently in one direction. The rates are somewhat lower for offspring born in the 1870 decade than for those born in 1850-1859 with one exception, that of the offspring of long-lived parents.

When the rates for ages 1-49 are compared with respect to the survivorship of the parents, the offspring of parents who died under 70 years experienced the highest mortality. The differences between the death rates for offspring of parents who survived to 70 and over

Table 4. Mortality at ages 1-49 among offspring born in each of three decades, classified according to age of survival of both parents.

AGE AT DEATH OF PARENTS	OFFSPRING BORN 1850-1859	OFFSPRING BORN 1860-1869	OFFSPRING BORN 1870-1879
	RATE PER 1,000 PERSONS PER YEAR		
Both Parents Survived to 70 Years of Age or Over	4.0	5.0	4.8
Both Parents Died Under 70 Years of Age	8.6	6.0	6.9
One Parent Died Under 70, the Other Survived to 70 or Over	5.4	5.9	4.8
	NUMBER		
Both Parents Survived to 70 Years of Age or Over	10,059	15,770	19,175
Population (Person-Years)	40	78	92
Both Parents Died Under 70 Years of Age	3,026	6,335	8,445
Population (Person-Years)	26	38	58
One Parent Died Under 70, the Other Survived to 70 or Over	10,955	20,792	25,168
Population (Person-Years)	59	122	120

and the offspring of parents who died under 70 years of age are greater than would be expected through chance variation for the decade 1850-1859, for the combined decades 1850-1869, and for the decade 1870-1879.*

The mortality experience for offspring born in 1850-1859 is combined with that for offspring born in 1860-1869, and age-specific mortality rates are shown in Table 5 for offspring of parents who survived to 70 years of age and over and for offspring of parents who died under 70 years of age. Those born in 1870-1879 are excluded because none could have been over 54 years of age at the time of enumeration. The death rates for the offspring of the short-lived parents are higher than those for the offspring of the long-lived for every age group except one. The excess varies from 43 to 77 per cent for certain age groups, namely, for persons aged 5-19, 30-39 and 70 and over. The greatest difference in the rates occurs at ages 40-49 where the excess is 162 per cent. For the remaining age groups the excess is relatively small.

When the differences in the rates for all ages and for ages 1-59 and 1-69 are tested for statistical significance, they are found to be greater than would be expected as a result of chance variation.* The

DECADE	RATE PER 1,000 PERSONS PER YEAR AND STANDARD ERROR OF RATE		DIFFERENCE AND STANDARD ERROR OF DIFFERENCE
	Offspring of Parents Both of Whom Survived to 70 Years of Age and Over	Offspring of Parents Both of Whom Died Under 70 Years of Age	
1850-1859	4.0 \pm 0.63	8.6 \pm 1.68	4.6 \pm 1.47
1850-1869	4.6 \pm 0.42	6.8 \pm 0.85	2.2 \pm 0.87
1870-1879	4.8 \pm 0.50	6.9 \pm 0.90	2.1 \pm 0.96

* The formula used for test of significance of the difference is:

$$\sigma \text{ diff.} = \sqrt{pq \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

AGE GROUPS	OFFSPRING OF PARENTS BOTH OF WHOM SURVIVED TO 70 YEARS OF AGE AND OVER	OFFSPRING OF PARENTS BOTH OF WHOM DIED UNDER 70 YEARS OF AGE
	RATE PER 1,000 PERSONS PER YEAR	
ALL AGES	8.0	10.0
1-59	5.4	7.3
1-69	6.8	8.6
1-4	14.5	17.1
5-9	3.9	5.7
10-19	3.1	5.5
20-24	4.1	5.2
25-29	5.8	5.3
30-39	3.2	5.0
40-49	2.9	7.6
50-59	9.8	10.2
60-69	19.3	20.5
70+	49.2	70.2
	POPULATION (PERSON-YEARS)	
ALL AGES	34,946	12,380
1-59	30,436	10,927
1-69	33,951	12,095
1-4	2,337	879
5-9	2,803	1,048
10-19	5,504	2,014
20-24	2,664	970
25-29	2,603	936
30-39	5,036	1,808
40-49	4,882	1,706
50-59	4,607	1,566
60-69	3,515	1,168
70+	995	285

Table 5. Mortality at specified ages among offspring of parents both of whom survived to 70 years of age and over compared with mortality of offspring whose parents died under 70 years of age. (Offspring born during the period 1850-1869.)

standard errors of the rates and of the differences are shown in Table 6.

The age curve of mortality which is shown in Figure 1 for each of the three groups of offspring born in 1850-1869 of long-lived

AGE GROUPS	RATE PER 1,000 PERSONS PER YEAR AND STANDARD ERROR OF RATE		DIFFERENCE AND STANDARD ERROR OF DIFFERENCE
	Offspring of Parents Both of Whom Survived to 70 Years of Age and Over	Offspring of Parents Both of Whom Died Under 70 Years of Age	
ALL AGES	8.0 \pm 0.48	10.0 \pm 0.90	2.0 \pm 0.96
1-49	4.6 \pm 0.42	6.8 \pm 0.85	2.2 \pm 0.87
1-59	5.4 \pm 0.42	7.3 \pm 0.82	1.9 \pm 0.85
1-69	6.8 \pm 0.45	8.6 \pm 0.84	1.8 \pm 0.90

Table 6. Standard errors of death rates and of differences in death rates at certain ages among offspring born 1850-1869 classified according to age of survival of both parents.

parents, of short-lived parents, and of one long-lived and one short-lived parent, presents very clearly the differences in mortality at successive ages. The curve for the offspring of one long-lived and one short-lived parent tended for the most part to be between the other two. The general picture resembles that shown by Dublin and Lotka (1) based on white male holders of policies of the Metropolitan Life Insurance Company issued during the period 1899-1902. Although the two studies are not entirely comparable, the relative positions of the curves are strikingly similar.

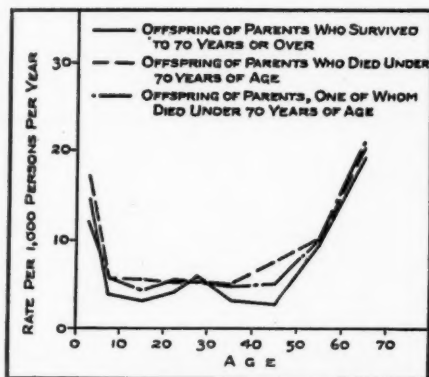


Fig. 1. Mortality at specific ages among three groups of offspring born during the period 1850-1869.

Another way of presenting the mortality experience is to show the proportion of persons alive at age 1 who survived to successive age periods. The survival curves for offspring born in 1850-1869 are

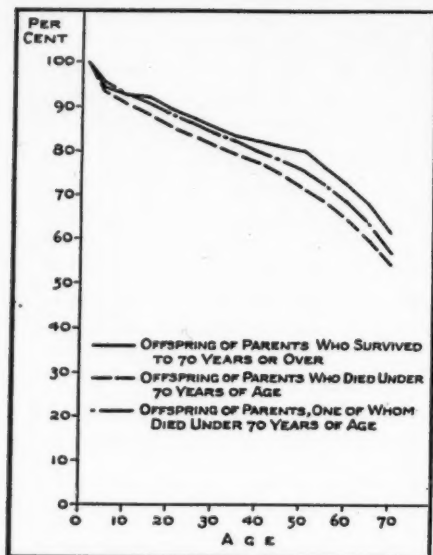


Fig. 2. Survival at specific ages for the three groups of offspring born during the period 1850-1869.

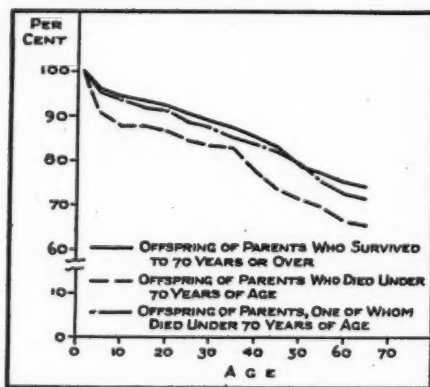


Fig. 3. Survival at specific ages for the three groups of offspring born during the period 1870-1879.

shown in Figure 2, and the number and per cent of survivors at specific ages on which the curves are based appear in Table 7. Figure 2 shows very clearly the relationship between the age of survivorship of parents and offspring. After age 10 the proportion of offspring still alive at successive ages was consistently highest for those whose parents survived to age 70 and over and lowest for those whose parents died under 70 years of age. When only one parent died under 70 years of age the per cent of offspring surviving to each successive age after age 10 occupied a position between the proportions for the other two groups. Still alive at age 50 were 80 per cent of the offspring of long-lived parents, 76 per cent of the offspring of one long-lived and one short-

lived parent, and 72 per cent of the offspring of two short-lived parents.

Survival curves for offspring born in 1870-1879 are shown in Figure 3, and the numbers and per cents on which they are based

Table 7. Number and per cent of offspring surviving to specified ages classified according to the age of survival of both parents.

AGE	BOTH PARENTS SURVIVED TO 70 YEARS OF AGE OR OVER		BOTH PARENTS DIED UNDER 70 YEARS OF AGE		ONE PARENT DIED UNDER 70 YEARS OF AGE	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
OFFSPRING BORN 1850-1869						
1	599	100.0	227	100.0	749	100.0
5	565	94.3	212	93.4	714	95.3
10	554	92.5	206	90.7	694	92.7
15	552	92.2	201	88.5	681	90.9
20	537	89.6	195	85.9	664	88.7
25	526	87.8	190	83.7	646	86.2
30	511	85.3	185	81.5	629	84.0
35	500	83.5	180	79.3	616	82.2
40	495	82.6	176	77.5	599	80.0
45	487	81.3	170	74.9	584	78.0
50	481	80.3	163	71.8	568	75.8
55	459	76.6	156	68.7	542	72.4
60	436	72.8	147	64.8	513	68.5
65	418	69.8	136	59.9	472	63.0
70	368	61.4	123	54.2	427	57.0
OFFSPRING BORN 1870-1879						
1	435	100.0	205	100.0	578	100.0
5	418	96.1	186	90.7	552	95.5
10	410	94.3	180	87.8	541	93.6
15	406	93.3	180	87.8	531	91.9
20	401	92.2	178	86.8	527	91.2
25	393	90.3	173	84.4	513	88.8
30	386	88.7	171	83.4	505	87.4
35	380	87.4	170	82.9	492	85.1
40	371	85.3	159	77.6	485	83.9
45	361	83.0	151	73.7	474	82.0
50	343	78.9	147	71.7	458	79.2
55	334	76.8	143	69.8	435	75.3
60	327	75.2	136	66.3	421	72.8
65	323	74.3	134	65.4	415	71.8

appear in Table 7. At every age the offspring of short-lived parents had the lowest proportion of survivors. The proportion of survivors was highest for offspring of long-lived parents at every age except one, and the survival curve for offspring of one long-lived and one short-lived parent tended to lie between the other two.

In both periods 1850-1869 and 1870-1879, a similar tendency was noted. The most favorable survival rates tended to occur among offspring both of whose parents lived to age 70 or over and the least favorable rates of survival were experienced by offspring both of whose parents died under age 70.

CAUSE OF DEATH OF PARENTS AND OFFSPRING

The question arises as to what were the causes of death of the parents and of the offspring and as to whether or not there was any relationship between the two. In Table 8 the causes of death of the offspring are listed for offspring born in 1850-1869 of long-lived parents and of short-lived parents. There is a marked contrast between the two groups in the death rates from infectious and parasitic diseases; the offspring of short-lived parents had a rate of 275 per 100,000 persons per year which is more than twice as high as the rate of 132 for offspring of long-lived parents. The offspring of short-lived parents also had a rate considerably in excess of the offspring of long-lived parents for rheumatism, diabetes, circulatory, respiratory, and digestive diseases. The only noteworthy excesses shown by the offspring of the long-lived parents were for nephritis and other genito-urinary diseases.

The causes of death of the two groups of parents are shown in Table 9. The most striking fact is the higher proportion both of fathers and mothers who died from infectious diseases in the short-lived group as compared with the long-lived group. This finding both for parents and offspring suggests that a family epidemic might have been responsible for the death of parents and children in the short-lived group. It was found, however, on reviewing the

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family records in which either parent had died from an infectious disease that there were few instances in which two members of the same family died of the same infectious disease, with the exception

Table 8. Mortality from specific causes among offspring of parents both of whom survived to 70 years of age or over compared with mortality among offspring of parents who died before reaching 70 years of age. (Offspring born 1850-1869.)

CAUSES OF DEATH	OFFSPRING OF PARENTS BOTH OF WHOM SURVIVED TO 70 YEARS OF AGE AND OVER		OFFSPRING OF PARENTS BOTH OF WHOM DIED UNDER 70 YEARS OF AGE	
	Rate Per 100,000 Persons Per Year	Number of Deaths	Rate Per 100,000 Persons Per Year	Number of Deaths
ALL CAUSES	801.2	280	1001.6	124
Infectious and Parasitic Diseases	131.6	46	174.6	34
Typhoid	15.8	9	48.5	6
Measles	5.7	2	0	0
Scarlet Fever	11.4	4	24.2	3
Whooping Cough	5.7	2	0	0
Diphtheria	18.6	10	113.1	14
Influenza	5.7	2	24.2	3
Dysentery	5.7	2	0	0
Tuberculosis	37.2	13	64.6	8
Other Infectious Diseases	5.7	2	0	0
Cancer	57.2	20	48.5	6
Other Tumors	2.9	1	8.1	1
Rheumatism	8.6	3	16.2	2
Diabetes	11.4	4	24.2	3
Diseases of Nervous System	111.6	39	113.1	14
Diseases of Circulatory System	88.7	31	105.0	13
Diseases of Respiratory System	42.9	15	72.7	9
Diarrhea and Enteritis	5.7	2	8.1	1
Other Digestive Diseases	51.5	18	80.8	10
Nephritis	22.9	8	0	0
Other Genito-Urinary	34.3	12	8.1	1
Pregnancy	14.3	5		
Accidents	63.0	22	80.8	10
Old Age	0	0	0	0
Ill Defined	34.3	12	16.2	2
All Other Causes	14.3	5	24.2	3
Cause Unknown	100.2	35	121.2	15
Population (Person-Years)		34,946		12,380

of tuberculosis in which the risk is known to be much greater for offspring of tuberculous parents (2). There was too long an interval between the deaths in almost every one of the few cases where members of the same family died from the same cause to suggest that the disease had been transmitted from one member of the family to another.

One notable difference in the causes of death of the two groups of parents is the proportion of deaths attributed to senility among parents who survived to age 70 or over. Out of this group 21 per

Table 9. Cause of death of parents who survived to 70 years of age and over compared with cause of death of parents who died under 70 years of age. (Parents of offspring born 1850-1869.)

CAUSE OF DEATH	BOTH PARENTS SURVIVED TO 70 YEARS OF AGE AND OVER		BOTH PARENTS DIED UNDER 70 YEARS OF AGE	
	Father	Mother	Father	Mother
	PER CENT			
ALL CAUSES	100.0	100.0	100.0	100.0
Infectious and Parasitic Diseases ¹	3.9	3.8	12.1	18.1
Cancer and Other Tumors	5.5	7.1	4.5	16.4
Rheumatic and Other General Diseases	1.1	1.1	3.0	3.3
Diseases of Nervous System	2.2	0	1.5	1.6
Diseases of Circulatory System	36.5	31.2	25.8	23.0
Diseases of Respiratory System	9.4	13.7	13.7	9.8
Diseases of Digestive System	2.8	4.9	9.1	8.2
Diseases of Genito-Urinary System	8.8	3.3	6.1	1.6
Diseases of Pregnancy and the Puerperal State	—	0	—	6.6
Diseases of Skin and Cellular Tissue	0	0	0	1.6
Diseases of Bones and Organs of Locomotion	0	0.5	0	0
Senility	21.0	24.0	0	0
Violent and Accidental Deaths	6.6	7.7	19.7	1.6
Ill Defined Causes ²	2.2	2.7	4.5	8.2
Cause Unknown	3.2	2.1	5.7	12.9
Number of Deaths	187	187	70	70

¹ One father and one mother who survived to 70 years of age or over died of tuberculosis. Three fathers and five mothers who died under 70 years of age died of tuberculosis.

² Two fathers and three mothers who survived to 70 years of age or over died of "dropsy." One father and five mothers who died under 70 years of age died of "dropsy."

cent of the fathers and 24 per cent of the mothers were reported to have died of old age. An additional 9 per cent of fathers and 8 per cent of mothers had senility listed as a secondary cause of death.

The two groups of parents differed with respect to certain other causes of death, but the differences were less marked in most cases than for the infectious and parasitic diseases and for senility. A higher proportion of both parents died from diseases of the circulatory system in the long-lived group and a lower proportion from diseases of the digestive system as compared with the parents who died under 70 years of age. Diseases of the respiratory system claimed more of the short-lived fathers but a smaller proportion of the short-lived mothers as compared with the long-lived group. Seven per cent of the short-lived mothers died from diseases of pregnancy and the puerperal state; no deaths were reported from these causes for long-lived mothers, since all must of necessity have survived the childbearing period in order to reach age 70 or over. A higher proportion of mothers' deaths in the short-lived group were reported as due to cancer and other tumors as compared with the long-lived group, but the validity of any figures on deaths from cancer for this period is questionable because of the possible errors and omissions in diagnosis. Among the fathers the proportion of violent and accidental deaths was considerably higher for those who died under 70 years of age than for those who survived to age 70 and over.

Caution should be observed in the interpretation of the data on causes of death of parents. The deaths attributed to senility among the long-lived parents form a relatively large group for which the causes of death are actually unknown. The proportion of deaths due to senility, ill-defined and unknown causes, was 26 per cent for long-lived fathers and 29 per cent for long-lived mothers; the proportion of deaths among short-lived parents from ill-defined and unknown causes was 10 per cent for fathers and 21 per cent for mothers. In spite of the limitations resulting from the relatively

large proportion of unknown causes, it is believed that the data on causes of death of parents are of sufficient interest to be presented here. The material on causes of death of parents gives some indication of possible differences in mortality causes between the two groups.

The findings of this report tend to confirm those of other investigators in that the length of life of offspring appeared to be related to the age of survivorship of parents. As Sydenstricker has pointed out, "Length of life, freedom from ill health, and vigor are subject to physical and mental heritage as well as to physical and social environment" (3). In a study based on family-history records it is not possible to control all of these factors. It was stated earlier in this paper that the population was a relatively homogeneous one, living in a rural area where there was a considerable degree of isolation. Probably extreme differences in environment were eliminated, but the fact that children shared the home environment of their parents for a relatively long and important period of their lives means that differences in modes of living among families may have been partly responsible for the differences in length of life among offspring and parents. The data presented here are offered as further substantiation of the belief that children of long-lived parents have a decided advantage over those of short-lived parents in regard to length of life. The advantage expresses itself in a postponement of the age at which death occurs. The difference in the length of life between the two groups is believed to result from the interaction of inherited characteristics and environmental conditions.

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2. Downes, Jean: The Risk of Mortality Among Offspring of Tuberculous Parents in a Rural Area in the Nineteenth Century. *The American Journal of Hygiene*, November 1937, No. 3, pp. 557-569.
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ANNOTATIONS

INCOME AND FOOD EXPENDITURE OF TUBERCULOUS HOUSEHOLDS IN WARTIME¹

THIS report gives the findings of a study "to find out whether tuberculous households and their component individuals are financially able to obtain adequate food during wartime. It is mainly an investigation into weekly household income and expenditure to discover the margin available for expenditure on food." The data included 1,346 households containing a tuberculous patient drawn from eighty-one tuberculosis dispensaries in England, Wales, and Scotland. The patients were persons with pulmonary tuberculosis who were in attendance at one of the dispensaries, or being visited by the tuberculosis officer or health visitor during the period July 1 to December 31, 1942. Also the patients had (a) been notified as tuberculous for over six months; (b) had or had had a positive sputum; and (c) were between the ages of 15 and 64 years. Thus the study deals with households of undoubted cases of tuberculosis, in whom evidence of the disease had been established.

The report does not discuss the exact clinical status of the given tuberculosis case, nor does it indicate what, if any, effect the available money for food may have had on the course of the disease in the patient or on his family. An adequate diet for a tuberculous person in relation to a standard normal diet could not be defined. Therefore, the comparisons presented in this report are based on what was accepted as a standard diet under wartime conditions for an apparently healthy person.

Despite these limitations, the report does indicate that in 31 per cent of the 1,346 families the available money for the purchase of food was below

¹ Report of Joint Committee, National Association for the Prevention of Tuberculosis and the Committee for the Study of Social Medicine, 1943. London, England, price, three shillings.

the amount needed for a standard diet for a normal person and family.² In families where tuberculosis caused the breadwinner to lose his employment, 45 per cent were below the standard as compared to 20 per cent below standard where the disease had not caused the breadwinner to lose his employment.

A number of other interesting conclusions are drawn from the data that further point up the usually accepted fact that the family with a tuberculous problem is, as a rule, at an economic disadvantage as compared to the family without such a handicap.

This handicap has been recognized by British health authorities in the recent adoption of Maintenance Allowances, which are given to patients who have to leave gainful occupations so as to insure proper treatment. On the assumption that all unemployed patients (662) would qualify for this additional allowance, it was estimated that the household money then available for food would be definitely increased. This increase would have greatest effect upon small households and less upon those with four or more persons. Should the wife of the householder-patient become gainfully employed, the addition of the Maintenance Allowance to the money available for food would place such households above the amount needed for the standard diet.

The evidence presented in this study was sufficient for the authors to recommend that the new Maintenance Allowance be made available to all families with notified cases of tuberculosis, rather than according to the present plan which restricts this Allowance to those cases who have a prospect of returning to normal work. They recommend also that the cost of the extra milk ration allowed by the Ministry of Food for persons suffering from certain tuberculous conditions should, when medically advised, be defrayed by the Tuberculosis Authority rather than by the individual patient.

This study, its conclusions and recommendations, adds some tangible evidence to the generally accepted dictum that the tuberculous individual and his family are at an economic disadvantage in their ability to provide a reasonable minimum diet essential to normal tissue growth and repair. The fact that persons in these families may have an added risk of more

² The weekly food cost used here is that compiled by the Ministry of Health early in 1942. It is based on low-cost diets containing, as near as possible, nutritional components in accordance with the standard of the League of Nations Technical Commission, and has been compiled according to prevailing rations, current British tastes, and prices in Great Britain, December 1941-January 1942.

rapid destruction of tissue than is normal, and consequently the need for a higher level of resistance, demands that tuberculous families as a rule should have a more generous food allowance than is possible in the apparently normal family where such handicaps do not exist.

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INSULIN SHOCK THERAPY¹

“ONE out of every four newly admitted patients to the New York State Hospitals suffers from Dementia Praecox, and because larger numbers of these patients remain for long periods of time they constitute between 50 and 60 per cent of all patients in the State Hospitals. Dementia Praecox is, therefore, a major factor in hospitalization as well as a challenging psychiatric problem.” In an effort to deal with this problem the Temporary Commission on State Hospital Problems under the chairmanship of Homer Folks has made an intensive study of the use of insulin shock in the treatment of dementia praecox patients.

The criteria for evaluating the effectiveness of insulin shock therapy were: (1) the ability of the patient to leave the hospital and return home, (2) the length of stay in the hospital, (3) the length of stay at home, and (4) the status of the patient after treatment with respect to his usefulness.

The study group consisted of 1,128 dementia praecox patients treated with insulin shock therapy between January 1, 1937 and June 30, 1942 at the Brooklyn State Hospital and a control group of 876 dementia praecox patients admitted to six other Metropolitan State Hospitals but who did not receive any form of shock therapy. The control group included patients who were comparable with the insulin treated group with respect to the time of hospital admission, eligibility for insulin therapy, diagnosis, and age, sex, and length of illness for each diagnostic group. The patients in the control group were matched in so far as it was possible so that they would be comparable with those in the therapy group in regard to all important factors.

The follow-up study was conducted by trained and experienced psychiatric social workers under the supervision of a director of field work. Every effort was made to locate patients and to evaluate carefully the

¹INSULIN SHOCK THERAPY. Study by the Temporary Commission on State Hospital Problems. New York, 1944, pp. 1-97.

patient's adjustment. The judgment of the usefulness of the patient was based primarily on his family and social relationships and on his ability to return to employment.

The principal findings of the Commission are as follows:

1. A greater proportion of the insulin treated group than of the control group was discharged from the hospital—79.5 per cent compared with 58.8 per cent.

2. (a) The average length of stay in the hospital before the first release was 3.8 months less for insulin treated than for control patients.

(b) A larger proportion of the insulin treated group than of the control group was at home the entire period from the date of discharge to the date of the study.

(c) The greatest proportion of hospital readmissions occurred within one year after discharge; after five years at home there were no readmissions.

(d) Of those readmitted to the hospital there was a greater proportion of insulin treated patients than of control, but more of the insulin treated were eventually released and were at home at the time of the study. The total time spent at home was greater for the therapy group than for the control and represented an average saving of 9½ months per insulin treated patient.

3. The insulin group had a larger proportion functioning as useful members of the community than did the control, 55.0 per cent as against 40.5 for the control group. The proportion returned to gainful employment was 71.1 per cent for the therapy group compared with 60.6 for the control group. There was a larger proportion of patients with a greater degree of usefulness among the insulin treated catatonics and paranoids, especially among the paranoids, than among those not treated with insulin. The proportion of less productive patients and hospital invalids was greater among the catatonics and paranoids not treated with insulin than among those given insulin shock therapy.

In addition to the above findings, the report presents a section on various factors affecting individual prognosis. Age, sex, length of illness, the nature of the onset of illness, and the length of time between termination of treatment and the date of the study are considered. Regardless of all these factors except sex, the insulin treated patients did better than the control patients, according to the criteria employed. A larger proportion

of males than of females was able to be discharged from the hospital and to become useful members of the community.

The report also contains a section on the economic aspects of insulin shock therapy, showing a saving to the hospital of approximately 286,695 days of hospital care and of \$80,774.60 in cost of food and clothing alone.

In view of the findings, the Commission makes various recommendations for extending the availability of insulin shock therapy, for securing greater consistency in its use, and for amassing further information regarding its use and results.

The Commission has made a definite contribution to the study of mental illness in the collection and analysis of the material presented in this report. The observation of a relatively large group of patients for a period of five and one half years affords interesting and valuable data. The fact that only 3.6 per cent of the total patients could not be located in the follow-up is evidence of the thorough and painstaking work which appears to have been done. The inclusion of a carefully selected control group makes the results of this study more conclusive than those of some of the studies which have preceded it in this field.

One question does arise in regard to the comparability of the control group with the insulin treated group, that is, whether or not there may have been different factors affecting the discharge of patients in different hospitals. The report mentions some factors which may affect discharge, such as the question of the environment to which the patient is to return. It seems conceivable that differences in social service departments, differences in the need for beds, and possibly differences in policies with regard to discharge might affect the comparability of some of the data. Since criteria other than ability to leave the hospital were employed, the raising of this question does not, in any way, invalidate the conclusions of the study or the recommendations made by the Commission.

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VACCINATION AGAINST TUBERCULOSIS^{1,2}

IN AN attempt to test the efficacy of a vaccine of heat-killed tubercle bacilli as a protective measure against tuberculosis, a study¹ was con-

¹ Wells, C. W.; Flahiff, E. W.; Smith, H. H.: Results Obtained in Man With the Use of a Vaccine of Heat-Killed Tubercle Bacilli. *American Journal of Hygiene*, September, 1944.

ducted in the Kingston Mental Hospital in Jamaica, B.W.I. This investigation was later extended² to include a sample of the general population of Jamaica. The results of both studies appeared in the September issue of the *American Journal of Hygiene*.

The mental hospital study covered a period of over ten years beginning in June of 1932 and continuing through December 1942. About 75 per cent of the patients in the hospital were colored, 95 per cent were 20 years of age or older, and the sex distribution was about equal. During the time covered the incidence of tuberculosis at the institution was relatively high; about 25 per cent of all deaths in the hospital were due to this disease. Four hundred and thirty-four cases of tuberculosis were discovered among the patients; of these, 61 (14 per cent) were tuberculous on admission and were excluded from the analysis.

Patients admitted to the hospital were tested within two weeks after admission with .01 mg. of old tuberculin. Negative reactors to this dose were retested with 1.0 mg., and those negative to this test were divided alternately into two groups, one of which was injected with a bovine strain of heat-killed tubercle bacilli (325 patients) and the other (312 patients) served as a control. The two groups were similar except for vaccination, and all were subject to close contact with open cases of tuberculosis in the institution. The average period of observation was thirty months for members of the vaccinated group and twenty-six months for the control group. Both groups received x-ray examinations within one month after admission, and these as well as tuberculin tests were repeated at intervals of from three to five months.

The vaccinated group maintained consistently lower attack rates than the nonvaccinated throughout the period under observation. Fourteen per cent of the vaccinated group developed tuberculosis as compared with 22 per cent of the control group. This difference was found to be statistically significant. The highest attack rate for each group occurred during the first year; 9 per cent in the vaccinated and 21 per cent in the control group. The difference between these attack rates was also statistically significant. In subsequent years the attack rates were consistently lower among the vaccinated patients than among the controls, although not significantly so in any specific period. These results indicated, according to the authors, that the protection afforded by the vaccine used was most

² Wells, C. W.; Flahiff, E. W.: Results Obtained With Heat-Killed Tubercle Bacilli Administered in a General Population. *American Journal of Hygiene*, September, 1944.

effective during the first year or eighteen months after vaccination and that after that time it was only slightly greater than the protection resulting from exposure to infection alone. It was also suggested that had both groups been isolated from contact with tuberculous infection during the first few months after admission when the vaccinated group was undergoing the process of immunity at the same time as exposure, the results might have been more startling.

Both the case fatality and the death rates from tuberculosis at specific intervals after admission were smaller, but not significantly smaller, in the vaccinated group than in the control group. However, the death rate for the whole period in the vaccinated group (11 per cent) was significantly less than that in the control group (18 per cent).

In order to determine the protective effect of the administration of heat-killed tubercle bacilli in persons weakly tuberculin positive, alternate positive reactors to 1.0 mg. of tuberculin were vaccinated after August 1938. The attack rate in this group (10 per cent) was lower than in the nonvaccinated group (21 per cent). This difference was not statistically significant. However, the authors interpret this result as an indication that partial immunity resulting from casual infection may be increased by vaccination.

From this study it was concluded that some degree of protection greater than that resulting from casual exposure to tuberculosis was afforded by the vaccine of heat-killed bacilli, and that such vaccination might be of practical use in groups of persons subjected to unusual risk of tuberculous infection.

The favorable results obtained in the group of mental patients encouraged Wells and Flahiff to investigate the practicability of vaccination in a general population. Such a study^{*} was conducted also in Jamaica from January 1939 to November 1942. The population observed included 4,186 persons from Kingston and 8,103 persons from rural Jamaica. Because of differences in exposure, urban and rural groups were analyzed separately. Alternate nonreactors to 1.0 mg. of old tuberculin were vaccinated and the other nonreactors formed a control group. Also, alternate reactors to 1.0 mg. but not to .01 mg. were vaccinated.

An attempt was made to re-examine by x-ray all those included in the study. Seventy-six per cent of all those vaccinated and 74 per cent of the controls were so examined. The authors suggest that the failure to com-

^{*} See footnote 2.

plete observation on 25 per cent of the original group makes the results inconclusive.

No statistically significant difference was found between a vaccinated group and the corresponding control group. The attack rates were very low in all the groups; five cases developed among 6,391 vaccinated persons examined and ten among 6,169 controls examined.

The results obtained in the general population were not significant as were those in the study of the mental patients. The authors attribute this to the low incidence of tuberculosis among those in the general population negative or weakly positive to old tuberculin, together with the relatively short period of observation, and to the loss of contact with 25 per cent of the persons originally included in the study.

The results of both studies taken together indicate that although vaccination with heat-killed tubercle bacilli shows promise of being an effective protective measure against tuberculosis, it will be necessary to accumulate more data before its value can be definitely established.

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